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TECHNICAL EDUCATION

IN

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SELECTED PAPERS FROM THE RECORDS

OF THE

BENGAL SECRETARIAT, P. W. DEPT.

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SELECTED PAPERS

FROM THE RECORDS OF THE BENGAL PUBLIC WORKS DEPARTMENT UPON THE SUBJECT OF TECHNICAL EDUCATION.

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CHAPTER I.

PROPOSALS FOR THE ESTABLISHMENT OF A SCHOOL FOR THE TRAINING OF PUBLIC WORKS SUBORDINATES.

No. 1250, dated Calcutta, the 28th February 1866.

From—J. GEOGHEGAN, Esq., Offg. Junior Secretary to the Government of Bengal,
To—The Secretary to the Government of Bengal in the Public Works Department.

I AM directed to forward herewith, in original, the correspondence noted on the margin and to request that you will be so good as to favour the Lieutenant-Governor with a full expression of your opinion as to the best plan for establishing a practical training school for engineers, as contemplated in Colonel Strachey's letter, and also that you will state whether it appears advisable to you to connect it with the School of Industrial Arts.

Vide Educational Proceeding, January 1863, Nos. 64-66. Ditto, July 1863, Nos. 186-187.

- Letter from Government of India, Department, Public Works, No. 3009, dated 6th August 1862.
- Memorandum by Major Medley, late Principal of the Civil Engineering College, dated 15th October 1862.
- Memorandum by Major Medley, late Principal of the Civil Engineering College, dated 25th idem.
- Letter from Director of Public Instruction, No. 1826, dated 26th May 1863.
- Letter to Goverment of India, Department, Public Works, No. 92T., dated 17th July 1863.

No. 1591, dated Calcutta, the 6th March 1868.

From—H. LEONARD, Esq., C.E., Offg. Secretary to the Govt. of Bengal, P. W. D.,
To—The Secretary to the Government of India in the Public Works Department.

I AM directed to request a reference to the letter from the Junior Secretary to the Government of Bengal to your address, No. 92T. of the 17th July 1863, and to the correspondence of which copies were forwarded therewith.

2. In that letter the Government of India were informed of the Lieutenant-Governor's concurrence in the suggestion that the Civil Engineering College should be brought into a closer relation with the Presidency College, regarding which the opinion of the Government of Bengal had been required by the Government of India (*vide* their Secretary's letter No. 3009 of the 6th August 1862), and in the concluding paragraph of the letter it was stated that the Lieutenant-Governor would afterwards submit a plan for the Engineering Training School, which had been suggested by Colonel Strachey, R.E., in the note which accompanied your office letter No. 3009 above referred to.

3. But although no scheme for such a school was at that time submitted, the papers forwarded will have been sufficient to inform the Government of India of the views entertained by the officers of the Educational and Public Works Departments who were consulted in regard to the point. It will have been seen that, though the idea of a training school met with very general approval, considerable doubts were entertained whether it would be possible to find men of the ordinary class of workmen sufficiently intelligent to receive the education required. The preparation of a scheme has since been delayed by these and similar doubts.

4. I am now directed to submit, for the consideration and orders of the Government of India, the enclosed copy of a note by the Officiating Chief Engineer, Bengal, on the subject; and to state that the Lieutenant-Governor entirely concurs in the views which are therein expressed. Should these views commend themselves to His Excellency the Governor-General in Council, I am to request that the Lieutenant-Governor may be authorized to set on foot the arrangements proposed in paragraphs 8 to 12 of the note.

5. I am also to solicit the serious consideration of the Government of India to the suggestion contained in the 7th paragraph of the Officiating Chief Engineer's note for the re-establishment of an Iron Bridge Yard at Calcutta.

6. As the scheme submitted contemplates a practical training under the direct supervision of the Public Works Department, the matter has been taken up in this department, though the previous correspondence on the subject was carried on through the office of the Secretary to the Government of Bengal.

Note, dated the 24th February 1868, *by* Mr. H. Leonard, *Officiating Chief Engineer of Bengal, on the Lower Training School for the Public Works Department.*

This heading has been used in paragraph 5 of Colonel Strachey's letter No 3009 o 6th August 1862, and it seems to me to express what is required much better than a definition used by him further on in the same letter and in a note which accompanies it, where he describes what he proposes as an institution for educating *mechanics*; by which, I suppose, is meant working mechanics, as in another part of the note he describes them as "practical artizans."

2. An institution for the practical training of departmental subordinates, I look upon a one of the real wants of the department: indeed, just now it seems to be one of the most pressing wants; while I think a school for the practical training of *artizans* altogether unnecessary, and I believe it would be unsuccessful if tried.

3. Nothing will make a good artizan but working with his own hands *for years* under or beside a good master: without such a training he will never be able to earn his bread as a workman, and I will even venture to say that he would not work a whit better if he knew how to survey, draw and calculate, than if he were in total ignorance of these acquirements. I do not mean to argue that it would not be most desirable to have him, as well as every other member of the community, usefully educated. on the contrary, I would have the means of an useful education at every man's door; but I say that, as a rule, it would not make him a better workman, and that he can be made a thoroughly good one without any such education.

4. The best practical way of making a good workman is to have overseers in all grades, who know what good work is and how to get it done. When the father has to work up to a good standard, the son will soon learn to work up with him, and thoroughly good work will be the result, without any special scheme for their education. In proof of the correctness of this opinion, I may instance Akra. Seven years ago the work done there was as bad as it is possible to conceive—disgracefully bad; now it is so good that any department may well be proud of it, and yet there was no special educating of the artizans, no effort to have any education whatever; the only task required was good bricks; men were shown how to make them, and the desired end has been attained most fully, the secret of success being that the Superintendent thoroughly understood his work, and patiently, but persistently, insisted on having good work done.

5. On the other hand, the necessity for some arrangements for giving a practical training to the supervising subordinates of the department is, as I have said, very great—so great that few people unconnected with the working of the department can understand how urgently it is needed. I know of no other country where the only qualification required from an overseer—that is, from the man who has practically to get the work done—is a purely theoretical education. In most countries a man is made an overseer because he is a thoroughly good workman, or because, being a fair workman, he is unusually smart as a manager, quick in contriving, neat in arranging, or has some such special qualification; but here the only qualification required is such as a man can attain, and does attain, without ever having seen a rupee's worth of work done, ever having shown the slightest aptitude for contrivance or management, or even any bent for the particular line which he has chosen, beyond the bent to earn a living as easily as he can. A lad of this sort passes his examination in college, is posted to a division, and straightway is sent to an out-station to build a set of sub-divisional buildings, to make a road, or to build a bridge perhaps: no wonder if we have to complain of bad work, if we are cheated, and if progress is often slow. Perhaps it may be said that such men *should not* be sent to do work: the answer is that Executive Engineers are driven to do so. If a dozen such lads were posted to some circles now, they would be all required at once to take up the numerous sub-divisional buildings which are springing up all over the country, and for the superintendence of which there are no other hands available: these lads, as soon as posted, are all on the strength of the department, and being on it, while the present press continues, they must be used It would be waste of time to say more as to the *necessity* for some means of improving this state of affairs Every engineer in the department must feel the want of it, and would, I think, be only too glad to give all the aid in his power to improve it; but the best means of doing this is a question on which there is room for, and probably on which there is, great difference of opinion.

6 I cannot see how a *school* can be worked which would provide the education required. To be useful, it should combine the means of giving instruction in all the classes of work used in the department, and especially in those most frequently used,—such as house building, bridge construction, good carpenter's work in doors, windows, &c If it did not do all this, it would be of little practical value, and I do not see how this can be done in a school without incurring enormous expense: even then there would be a kind of toyism, a want of reality, about the work done, which would detract much from its value I know of no such school. The only successful institutions of the kind with which I am acquainted are "model farm schools" for teaching agriculture and gardening; but the difference between the class of work done in these schools and that which we require is manifest; while it is quite practicable to keep a model farm always worked, and worked, too, without much loss, it is not at all practicable to keep perpetually building structures on the school ground, whether the buildings be houses, or bridges, or weirs, without enormous expense and loss.

7. There are certain kinds of work which might be done in such an establishment with great advantage. For instance, I am one of those who think the abandoning of the iron bridge yard by Government a mistake, and taking it in connexion with the establishment of a training school, a great mistake. A yard for the manufacture of all kinds of ordinary ironwork, and all kinds of easily transportable woodwork, might be kept up without much, if any, loss, and with great advantage in an educational point of view, just as Akra is kept up without loss and is invaluable in another branch of work; and it may be well worth consideration, if this idea

of practically educating subordinates be carried out, whether Government should not establish a yard for the execution of our own work, worked just as Akra is, partly for the purpose of getting good work, and partly as a means of giving sound instruction to our subordinates; but I cannot see how an establishment which would afford the means of giving a good practical education in all the necessary branches can be kept up and worked. I believe, however, that no such general school is required, and that lads can be much better trained in a different way and at very much less expense.

8 I think that if actual practical training be required as a qualification, changes in the present system of theoretical education must be made; the standard of first admission to the department must be lowered: it would be too much to expect the same theoretical knowledge as is now exacted, and a good practical training as well. My idea is that there should be a school—call it a Public Works Subordinate School—into which lads would enter on passing certain easy tests, the education for which could be acquired in *any zillah school*: the test should be merely a tolerable knowledge of English, and a fair acquaintance with arithmetic and mathematics. In this school the boys should learn *simple* surveying, plan drawing and estimating, and easy practical mechanics; but in none of these branches should they be required to learn anything more than would make them useful as *overseers* (let assistant engineers do all scientific work); then they should be sent out as apprentices to learn practical work.

9. I think the best means of providing this class of instruction would be to have certain selected divisions where the most useful works were going on—these divisions might be changed from time to time—in each of which a thoroughly good subordinate should have nothing to do but to take charge of the pupils and teach them actual work. To enable him to do this, certain works might be made over to him by the Executive Engineer, which he would carry out just as if they were being done by contract, and on these buildings the pupils should work with their own hands, so far as it may be necessary to make them thoroughly acquainted with the nature of good work, and how it should be done. In the meantime, while gaining this practical knowledge, they might be allowed the means of improving their general knowledge, if they desired to do so, either by making suitable arrangements with the zillah school, or with their own Superintendent.

10. I think all might enter the school in the same grade, leaving them to come out of it, and from their apprenticeship, in whatever grade their certificates on leaving might entitle them to, the qualification being a proper proportion of theoretical and practical knowledge. I would even make high proficiency in one particular branch of practical knowledge carry very great weight in qualifying for a certificate, and as so much time must be devoted to the acquirement of an acquaintance with practical work, I would lower the standard of theoretical knowledge very considerably below what is now required.

11. As to the time required for the qualifications of a pupil, I think three years is probably a fair time to fix—one year to school work, and two to the necessary out-door apprenticeship. An indulgence might probably be made allowing an industrious lad, who failed to qualify within the prescribed time, to remain four years. These, however, are matters of detail, which it is hardly necessary to go into in a note of this sort.

12. I think lads might pay for their schooling, but have a fair number of scholarships by which the best boys might gain a prize sufficient to pay for their school expenses During the out-door services a small allowance might be made to each pupil, which would probably be covered by the value of the work done by them, or the value of the work done might be given direct to the pupil; but in this stage also I would have scholarships as a reward for industry and intelligence.

13. If these views, or any others producing similar results, were carried out, I would abolish the grade of sub-overseer altogether, substituting artizans selected from the *workmen* as foremen for special work: these men would be foremen in the true sense of the word, merely seeing that good work was done, and having nothing whatever to do with measurements or accounts. At present sub overseers are a non-descript sort of subordinate, without any practical knowledge whatever, and with just enough learning to enable the overseer to throw his duties into his subordinates' hands: they are almost useless in the department, unless when they take the overseers' place fully and openly, then they are often just as good men as the overseer. I am satisfied that the substitution of ordinary intelligent artizans—many are to be found—for these sub-overseers would be a decided improvement.

14. Regarding any connexion between the proposed school and the School of Art, it will have been seen from the views already expressed that any such arrangement would not be practicable; but even if it were, I think it would not be useful: what we want now is really practical knowledge of the work which we actually have to do. We have very little art decoration in our department. Whenever a special case occurs, we can always have the aid of the school as it now stands; but adding the knowledge which is acquired there to that which we are in real want of would only delay the acquirement of the latter, and indeed, I think, it would have an injurious effect on Bengali lads, who are always fond of showing off their acquirements even under most inappropriate circumstances. I remember the case of a clever young overseer who was putting up a spur at Bamunghatta to save the toll-house from being cut away by the action of the river When I pointed out to him that he had not done it as he was told, and that it would not protect the bank, he produced a paper covered with algebraic signs to demonstrate that it was made in the proper position to enable it to resist the current, though it certainly would not protect the bank. I fear that it is quite possible that a young overseer who had a smattering of art learning might neglect the proper bond of his brickwork, and satisfy himself with the assurance that the arrangement was highly artistic. In fact, we shall find it very difficult to get the amount of useful information, which we so much require, ground into these very theoretical Bengali lads, and I am satisfied it would be a mistake to distract their attention from the really important work at which they will have to earn their livelihood by any connexion with even so good an institution as the School of Art.

No. 722E., dated Simla, the 5th May 1869.

From—Col. R. Strachey, R.E., Offg. Secretary to the Govt. of India, P. W. D.,
To—The Secretary to the Government of Bengal in the Public Works Department.

In reply to Mr. Leonard's letter, No. 1591 of the 6th March 1868, on the subject of the formation of a Lower Training School for the Public Works Department in Bengal, I am directed to request that His Honor the Lieutenant-Governor will submit, for the consideration of the Government of India, specific proposals for carrying out whatever plan of operations seems to His Honour best suited to the object in view.

2. As such delay has arisen in dealing with the former proposals, the Hon'ble the LieutenantGovernor may, on reconsideration, find cause to modify some of his former conclusions, but I am to assure him of the cordial co-operation of the Government of India in giving immediate effect to whatever plan he may now deem best.

3. In conclusion, I am to express regret at the delay which has occurred in replying to the letter under acknowledgment.

No. 5670, dated the 4th October 1869.

From—Col. J. E. T. Nicolls, R.E., Secretary to the Govt. of Bengal, P. W. D.,
To—The Secretary to the Government of India in the Public Works Department.

In reply to the letter from your office, No. 722E. of the 5th May 1869, in which the support of the Government of India was promised to the practical school which the Lieutenant-Governor had proposed to establish for the purpose of training a subordinate engineering staff, I am directed to submit a copy of a note on the subject by the Chief Engineer of Bengal, and to state that the Lieutenant-Governor considers the matter to be of vital importance, and regrets that press of other work should have prevented its being earlier brought forward again.

2. I am to ask for particular attention to the last paragraph, concerning the transfer to this department of the workshops of the Calcutta and South-Eastern State Railway, and to state that the measure seems to the Lieutenant-Governor a desirable one in every way.

Note, dated the 30th September 1869, by Col. J. E. T. Nicolls, R E., *on the means of giving practical knowledge to candidates for employment in the Public Works Department and others.*

"I would accordingly propose to create what may be called a Professorship of Practical Engineering, the holder whereof should be in the position of an Executive Engineer in the Public Works Department, and so be duly responsible for the work he did. He should, in short, be head of a model division, which should consist of one or more large works, such as the large Presidency buildings, some large bridge or similar important work. He should be assisted by a subordinate staff as necessary, and should teach practical construction, including management of work and of work-people, proper keeping of accounts, checking quantities, &c., and he should be responsible for the attendance and behaviour of his pupils. He should take the pupils from the Civil Engineering College in whatever grade they may have passed out, and employ and train them accordingly. He should also take practical workmen, and train them, giving them the eventual advantage of his certificates; and a certificate from him that a man was a thoroughly practical man, and could keep the usual accounts and measure up ordinary work should be sufficient qualification for employment in the lower grades of the department. The present scholarships might remain for the upper grades; practical workmen should be paid the value of their work; and the overseer and sub-overseer class should receive subsistence allowances in such numbers as it may be thought desirable to keep in training for the department.

"Mr. Leonard's remarks about the want of practical knowledge and efficiency in this class of men are not too strongly put. This want is one of our great drawbacks.

"His remarks about sub-overseers are all most just. It has been my opinion from the time the change was made that the step was a false one. In setting aside darogahs, jemadars, or whatever the designation may have been, a valuable practical agency was done away with, without any adequate substitute being given, and the circumstances tending to develope practical knowledge have become worse since the measure was adopted, the introduction of the contract system having taken away such necessity as previously existed fo the subordinates taking up the practical management of work."

The above paragraphs from a recent note indicate the means that I would adopt for the practical training of the candidates for employment in the Public Works Department, and I will now fill in the sketch and enlarge on the subject.

2 The branches of work on which practical instruction is most necessary are –

Brick-making.	Carpentry and joinery.
Brick-laying.	Ironwork.
Building.	Machinery.

And the best way of ensuring competent instruction in these branches seems to be to place the pupils under the tuition of practical men from England—men who have served their time, had experience, and become foremen in their trades. In short, men like Mr. Hickmott, the Superintendent of the Akra Brick Factory, who can show what is required, and explain their instruction by practical illustration.

3. It will be necessary, however, that this instruction should be closely supervised, in order to ensure discipline, attention to the instruction, uniformity and sufficiency in the course. It will also be necessary that the reasons of the methods used and the causes of the effects produced should be explained to the students in each branch of work.

4. The strength of the supervising staff must depend on the extent and details of the course of instruction determined on, the numbers of the pupils, the number of places to be visited, and their distance apart, &c. These points cannot be accurately determined at present, but a Professor and an Assistant Professor will at least be necessary in addition to the practical instructors already mentioned.

5. The next point seems to be the best way in which the instruction can be given.

6. As regards brick-making Everything is ready to hand at the Akra Factory, except shelter for the pupils. But as brick-making is carried on during the fine season, the pupils could live in tents if no better arrangement proved possible, and the course of instruction could, no doubt, be so arranged as to have the pupils at brick-making during the cold season if this were necessary.

7. Brick-laying must, of course, be dependent on what work happens to be in progress, for the expense would be too great to attempt brick-laying for the mere purpose of tuition.

8. The same may be said of building generally.

9 For the present there is sufficient brick-laying and building in Calcutta to afford the necessary instruction. There will in all probability always be sufficient of these works in Calcutta or its neighbourhood (although, perhaps, not on the present scale) to afford the necessary means of imparting instruction. If not, it is tolerably certain that there would be large works elsewhere, and an additional Assistant Professor to take charge of the detached party, who would probably save the appointment of another officer, would seem to be all that would be required, in addition, perhaps, to some expense in travelling allowances, &c. The contingency of there being want of brick-laying and building work for the instruction of the pupils does not seem of importance enough to require further notice now.

10. Carpentry and joinery are matters requiring especial attention as regards improvement in our present style of working, and for this purpose, as well as to carry out proper training and to secure the great advantage of having the work-people generally properly instructed in good carpentry, it is essential to have a properly organized yard for instruction in this branch of work. All joinery work should be done therein, and any possible carpentry work, until a better standard is established outside. The yard should not only work for Calcutta, but for the mofussil as well. Much of our timber is now sea-brought. The railroad and inland steamers offer ready means of conveyance, and in many cases it will probably be advantageous as regards the quality of the work to make up much of our joinery here, and profitable also, especially if machinery is brought into play, as can be done.

11. In some instances, indeed, it is perhaps scarcely optional to avoid making up woodwork in Calcutta, as difficulties are reported arising from failure of supply of timber up-country, owing to want of forest conservancy in former days, difficulties and expense of carriage, &c., and if supplies for up-country must come over the sea, it will doubtless be better, owing to the decreased cost of carriage, to forward the manufactured than the raw article to the mofussil, even though the cost of labour in Calcutta may be higher. This is, however, a detail not requiring immediate settlement.

12. An iron yard is also essential, not only for training purposes, but on general departmental grounds. Our use of ironwork is daily increasing. The quickness with which iron structures can be put together, their strength and durability, the facilities in some instances of executing difficult work in the foundation of bridges or in large roof spans, &c., often combine to make it desirable to use iron, which in the shape of iron girders or screw-pile piers is also admirably adapted for many of the inundated tracts of country crossed by our roads, and for some of our rivers. In the eastern districts, where labour, and specially skilled labour, is scarce and difficult to manage, where these causes and the seasons of the year render it difficult to manufacture bricks, and where the unhealthiness of the country renders it inexpedient to expose our engineers and their work-people unnecessarily to malarious influences, the use of iron promises to be of much service. The use of iron has accordingly been growing of late years, and we are finding that we are not properly organized for such work, and that we are in want both of efficient supervision and the means of carrying out such works. Some of our engineers from England have certainly served their time in ironwork, and are most useful; but they cannot be employed everywhere, nor yet always be made available. Good supervision is essential, not generally available, and it is very necessary that our establishments as a body should have knowledge of this branch of their profession. This is the more requisite if we rely on ourselves, as we should be able to do, and do not lean on contractors for this description of work, as at

present we are almost entirely compelled to do in consequence of our establishments not being trained and experienced in this description of work. As long as ironwork was confined to the Presidency, reliance on contractors was not of so much importance, as work was better under supervision, and there was a selection of contractors, but the matter has assumed a new aspect since ironwork has extended to the mofussil. The employment of contractors is unavoidable in many instances They, again, possibly have no other work in the neighbourhood, and consequently have to depute a special agent to look after the job, whose salary bears heavily on the expense of the work. This agent again cannot be efficiently supervised by his Principal. and any supervision there may be is an addition to the cost of the work in consequence of the loss of time occupied by the contractor on the journey and his expenses in travelling. Such difficulties and expenses would be great in such places as Assam, which are so distant, and which present so many difficulties.

13. The rule which prescribes that all ironwork from England should be got out through the Secretary of State may also add to the expense of working by contract, as it throws all the contractor's profit on to the cost of setting up the structure. On the other hand, this may be counterbalanced by the lesser rate at which it is understood that the material is procured by the Secretary of State. But however this may be exactly, the Government must have the work properly supervised under any circumstances, and this supervision of itself should almost suffice for executing the work without contractors.

14 More need not perhaps be said in favour of the importance of giving a good knowledge of ironwork to our establishments, both high and low, and of the material advantages to be derived by Government therefrom What I would now propose is to have a yard, wherein our recruits could thoroughly learn making trusses and girders, setting up ironwork, making good petty deficiencies in ironwork sent out from England, &c., leaving their knowledge of the larger operations connected with ironwork to be obtained, as may be practicable, from the Mint, Cossipore Foundry, &c.

15. Practical knowledge of machinery should be gained in like manner partly in the yard, partly at the Mint, Cossipore Foundry, and other establishments.

16 The practical knowledge imparted in these various branches of work should be supplemented by instruction from the Professors, who should, as necessary, explain the reasons and theory of what was being done. In some instances this would take place on the spot; in others, in the class or lecture room

17. Besides this the Professors should instruct in measuring up work, checking the quantities of labour and materials used, keeping a control over expenditure, and the account operations necessary to be understood by the different classes of students. The large staff at the command of the Professor would place his works under complete supervision, and give a full power of control over the quality and cost of work, and it might be expected that work would be unusually well and cheaply done, and results obtained, which could be held up as models and standards to influence and regulate the department generally.

18. The foregoing proposals are mainly framed with a view of meeting our departmental requirements, but they would also be of great value, with some modification, for the general training of an Engineer, or could doubtless be made so, by allowing any one who wished to do so to take up specially any particular branch that he might desire.

19. Whilst, then, this practical school is being established mainly for Government ends, I am strongly of opinion that it should, as far as possible, be made to embrace training for general works, and I may illustrate this opinion by quoting further from the note already alluded to.

"I would here remark that I have not proposed to guarantee any number of appointments, because I think that the Civil Engineering College should be an institution for supplying indigenous engineers for the country generally, and something beyond a mere supplier of Government requirements, which guaranteeing its pupils Government employ would tend to make it. Such assistance also seems quite unnecessary,—witness the large increase of students now taking place. If this increase is due to the prospect of increased Government employment, then it is evident that there is already sufficient inducement; if on the other hand the increase arises from causes unconnected with Government employment, anything, such as a guarantee, that would tend to bring students to look to, and depend upon, Government would be prejudicial. It has already been noticed that, as it is, the supply seems exceeding the Government demand; and if this is correct, Government ought not to do anything to increase the attractions of the college, as dependent solely on itself. Again, the present state of things is advantageous to Government, which has no obligations beyond the scholarships, and can therefore select such of the candidates as are best; and it is also probably advantageous to the public, because there will most likely be a number of disappointed candidates who, under the pressure of circumstances, will possibly feel called on to take a step which, without some such pressure, they would be unlikely to take, and will turn independent engineers, as contractors or otherwise, and so tend to solve the question as to the capabilities of Bengali engineers for practical work."

20. Under this view, I think that the practical Training School should take (within its means of doing so) all of good character, and who have sufficient education or qualification to afford a reasonable expectation that they are likely to profit by the course. Preference would, of course, be given to pupils from the Government Civil Engineering College, to whom this school would be but a continuation of their college course.

21. If the increased numbers who are now flocking to the Calcutta Civil Engineering College are to be taken as an index of a desire to enter Government employ as opportunity offers, it would perhaps be unnecessary to offer, as is the case now, special inducements in the shape of scholarships in order to induce candidates for public employment to undergo a course of practical training. But however this may turn out eventually, the existing system should stand for the present, and it might be laid down that pupils from the Civil Engineer-

ing College, who had qualified under present rules, should have the present scholarships (five in number) of Rs. 50 a month each. Scholarships of Rs. 30 per month each might be created for those that had qualified as upper subordinates. All others should attend at their own expense, except real workmen, European or Native, who should receive fair wages for their work, and should be employed as far as may be possible.

22. The present grade of sub-overseer has been purposely omitted in the above arrangements, because the men who occupy this grade should be practical and experienced workmen, to whom the pay of the grades would be a valuable and a strong temptation to qualify for and gain this situation. The present grade of sub-overseer in no way represents such a class of men, though the necessity for it is obvious. The sub-overseers are a set of persons who are often sufficiently well educated to take up overseer's duties, for which, in many instances, they are duly qualified by examination, and whatever their other qualifications, they are certainly not of the better class of workmen. There is consequently a tendency in such men to be above the work their class ought to do, and a tendency in officers who are pressed to push on work and require assistance, to entrust the higher duty of overseer to these men, and to place them in positions above those for which they are paid. It would be better to do away with the sub-overseer's designation altogether, letting the *status* remain under a designation which shall keep a marked distinction between it and the overseer's class, and shall indicate better the duty required of them. They might be called sirdars or sub-foremen.

23. The present sub-overseers, if qualified for the overseer grade, might be placed in that class as vacancies occur, or be placed in the new class of sirdars if qualified therefor; some of the remainder might find employment in offices, or otherwise; the remainder might be discharged with the usual gratuity.

24. Although the primary object of this school is to afford our country-educated youth the advantages of practical training, I think that, if possible, the young Civil Engineers from England should pass a little time in the school, greater or less, according to circumstances. In many cases there would be little in the way of general practical knowledge to be obtained by them, but they would get ideas of our Indian system and of the work to be expected from natives. It is a great thing, as regards the public service as well as regards his own interests, for a young man to start with proper ideas of what he has to do, and to be brought in contact with good influences at first starting.

25. The selection of a good staff for this school is of much importance, and perhaps of some slight difficulty. The Principal must not only be a good practical engineer, but he must possess good theoretical knowledge, must have experience of the country and its work-people, its system of labour and the system of the department. He also must be of a kind disposition, and one who would look after and beneficially influence the young men under his care. His salary ought to be liberal, certainly not less than that of a first grade Executive Engineer, Rs. 900 a month, with the usual allowances. His assistants should be selected men of the grade of Executive Engineer. The foremen should have salaries varying from Rs. 200 to Rs. 400 according to qualifications and length of service, and I think that it is particularly to be desired that such men should not be classified with the ordinary establishment. Allusion has already been made to the amount of the scholarships.

26. Besides the cost of these salaries and scholarships, expense will be necessary for forming the carpenter's and ironworker's yards. The expense is roughly estimated in paragraph 29, and it is difficult to estimate more correctly now owing to the scale on which work will be carried on not being known, and to the sites for these yards not having been fixed. The above sums will serve to start with, and expansion may take place hereafter as may prove desirable.

27. The question of site is one of some difficulty. The site ought to be on the banks of the river, or some navigable channel, because the iron and wood used will be all water-borne, and it will save much trouble and expense to be able to land these articles at once at the spot where they are wanted. The site should also be near at hand, both to save expense in conveying the materials to the works, or to the railway station for despatch to the mofussil, and for convenience of the work people and of supervision. The place which seems to me most suitable for the carpenter's and iron yards is the strip of land on the north bank of Tolly's Nullah, between the Kidderpore and Zeerut bridges. There does not seem to be any serious public objection to placing these yards in this position, because, with the exception of a small dwelling house for the Superintendents, who must live on the spot, the buildings would be low, and the whole arrangement as unobjectionable as the old iron bridge yard close by, which is now occupied by the Telegraph Department.

28. It would also be necessary to provide class rooms, and this would be best effected, at any rate for the present, by hiring a suitable house.

29. The expense of the scheme may be briefly summed as follows:—

			Rs.
Monthly salary of Principal, say	...	...	900
Ditto of Assistant ditto	...	...	600
Ditto of four Superintendents of the branches of work, from Rs. 200 to Rs. 400, or say	...	...	1,200
Senior scholarship for five engineer grade students		...	250
Junior ditto, say upper subordinate, ditto	10 at Rs.	30	300
Subordinate ditto ditto ditto	10 „	25	250
	Total	...	3,500

To set up the yards and compound walls, say ...	...	Rs.	7 500
Residence ...	...	„	25,000
Worksheds and shops	...	„	25,000
Plant and tools for carpenters ..	...	„	12,500
Ditto for blacksmiths ..	...	„	25,000
Total	...	„	95,000

30. This sum may appear large, but part of the amount for salaries is already incurred for scholarships, and the principal and his staff and students represent a portion of the Public Works expenditure on establishment saved. The expense of carrying on the work of the yards would be more than covered by the value of the articles produced, leaving a profit upon the capital sum.

31. Besides all these, there would be the indirect pecuniary gain from improved work, both in that turned out from the yards and that throughout the country, which would be influenced by the work in the yards, which it may be supposed would give out for general employment better trained and more competent men than there are at present, and this gain, which it would be difficult to measure exactly, would be by no means small.

32. It may be added further that the country in its present state of development as regards engineering work requires such an institution.

33. Besides all this the advantage to the Government arising from this school should be very great in other ways. Much of our work in Bengal is of a detached nature, such as canals, embankments, roads, small civil and sub-divisional stations, where the junior engineers and the subordinate staff cannot be kept under close supervision, and as we are situated at present they cannot be kept under supervision and instruction at the head-quarters of Executive Engineers for a sufficient length of time to qualify them to take up detached duty properly. Some indeed have scarcely any tuition, so great are the press of work, the short-handedness of the establishments, and the vacancies caused by sickness and transfers. It may therefore be fairly anticipated that, if our young officers and subordinates are trained as proposed in practical work, management of work-people, and checking expenditure, the advantages when they enter upon their duties must be very great in this as in other ways.

34. Enough has perhaps been said to show that an institution for practical training is of great importance and likely to be of the greatest benefit. It is a question that requires to be earnestly taken up, and its successful working will, I trust, be the means of eventually placing the Public Works of Bengal on a far better footing than they are at present when labouring under such serious disadvantages as now cripple and paralise them.

35. Since the preceding part of this note was drafted, I have become aware of the workshops of the Calcutta and South-Eastern State Railway being no longer required for their especial purpose, and of there being a desire to utilise them. Their position is not so good as that brought forward in paragraph 27 of this note, being remote from the river; but there is railway communication with the river by means of the municipal railway to Baug Bazar Ghât, and although this extra carriage would tell against the cost of working the carpenters' and iron-smiths' shops, still there is so much in favour of the Sealdah site that I would recommend its adoption.

The following are briefly the reasons for adopting Sealdah:—

1st.—The school could be got into operation soon, and this is a matter of great importance. Buildings and machinery are ready to a considerable extent. What more is required in the way of adapting the place to the school and getting it into working order would afford an opportunity to the students of commencing their instruction at once.

2nd.—The Government buildings in the neighbourhood afford the means of supplementing any deficiency of accommodation; and convenient and suitable class rooms, &c., &c., could be provided.

3rd.—A great deal of what is required to set the institution on a satisfactory and good footing could be *at once* obtained without cash payment, and what is required would not call for a large cash expenditure.

4th.—It would be unnecessary to occupy the proposed site, the occupation of which would undoubtedly be regarded by the public with disfavour, as trenching upon the maidan, though this would not be sufficient reason for not taking it if no alternative existed.

No. 52E.G., dated Calcutta, the 10th January 1870.

From—The Secretary to the Government of India, P. W. Dept.,
To—The Secretary to the Government of Bengal in the Public Works Department.

THE Governor-General in Council has had under consideration the proposals submitted in your letter No. 5670 of 4th October last, for the establishment of a lower training school for the Public Works Department, and I am now to communicate the views of His Excellency in Council on the subject.

2. The Governor-General in Council has grave doubts as to the practical utility of establishing a workshop entirely or mainly for students. A shop for engineering purposes to serve as a school must be conducted in a thoroughly efficient and economical manner. It would be hopeless to expect either efficiency or economy in a shop in which work was mainly, or to any considerable extent, carried on by pupils, and it is manifestly essential for the purpose of instruction that both these considerations should be prominently brought before engineer pupils.

3. To give real effect to the intentions of the Government of Bengal in this matter, it seems to His Excellency in Council that one of two things must be done. Either some existing establishment of suitable character must be made use of, or if no such establishment exists, or is available, a new one must be organized on the basis of thoroughly efficient general mechanical shops, capable of turning out all the miscellaneous work needed for the Public Works Department in Calcutta and its vicinity. Shops for the purpose in view should have a variety of real, not fictitious, work to do, and the pupils who attend them should be required to work with their own hands, so as not only to be shown how work is done by skilled artizans, and how to discriminate between good and bad work, but also to acquire a proper knowledge of the manner of using tools and of performing work, so that they may in turn instruct and supervise others.

4. The Government of India will readily receive and consider any definite proposal for establishing such a shop, and the buildings of the Mutlah Railway seem to be conveniently situated and suitable for the purpose. Considerations, which need not be referred to in detail, indicate that some such arrangement might be found conducive to economy in the operations of the Public Works Department in Calcutta and its vicinity, and at the same time give the means of affording the sort of instruction that is so truly stated by the Government of Bengal to be greatly needed for the young men entering the department

5. The Governor-General in Council will be glad if the proposal is reconsidered in the light of these remarks, the Railway Department being also again consulted on the subject of the utilization of such an institution in connection with the working of the Mutlah Railway.

No. 309, dated Calcutta, the 24th January 1870.

From—COL. J. E. T. NICOLLS, R.E, Secretary to the Govt. of Bengal, P. W. D.,
To—The Superintending Engineer, South-Eastern Circle.

IN forwarding the enclosed copy of a letter, No. 52E.G. of the 10th January 1870, from the Secretary to the Government of India, Public Works Department, on the subject of the establishment of a Lower Training School for the Public Works Department, I am directed to inform you that the Lieutenant-Governor has been pleased to appoint you President and Major W. S. Trevor, R E., Superintending Engineer, Presidency Circle, and Mr. F. R. Boyce, Controller of Public Works Accounts, Members of a Committee for preparing a definite proposal for establishing an efficient and economical workshop such as is contemplated by the Government of India.

No. 2255, dated Calcutta, the 4th May 1870.

From—COLONEL J E. T. NICOLLS, R.E., Secretary to the Govt. of Bengal, P. W. D.,
To—The Officiating Superintending Engineer, Presidency Circle.

IN reply to your memorandum No. 1698, dated the 22nd ultimo, I am directed to inform you that the Lieutenant-Governor has been pleased to appoint Mr. F. R. Boyce, Controller of Public Works Accounts as President, and yourself as a Member of the Committee for preparing a definite proposal for establishing an efficient and economical workshop at the Presidency.

No. A., dated Calcutta, the 2nd June 1870.

From—F. R. BOYCE, ESQ., President of the Committee,
To—The Secretary to the Government of Bengal, in the Public Works Department.

WITH reference to your No. 2256 of the 4th May 1870, I have the honour to submit the report of the Committee on the proposal for establishing an efficient Workshop at the Presidency, and also a plan of the premises at Sealdah as referred to in the report.

Report of Committee appointed by the Government of Bengal to prepare a definite proposal for the establishment of a Workshop for the Public Works Department at the Presidency

F. R. Boyce, Esq., Controller of Public Works Accounts ... *President.*
T. S. Isaac, Esq., C.E., Offg. Supdg. Engr., Presidency Circle ... } *Members.*
W. D. Bruce, Esq., C.E., Exe. Engr., 2nd Presidency Division ... }

The Committee have had before them the Government of India's letter No. 52E.G. of the 10th January, together with such information as was available as to the probable demands for work in the event of workshops being established, and the usual rates at which work is done at the Presidency. They have also inspected the buildings in connection with the Mutlah Railway referred to in the above letter and the machinery which is in that establishment, and, having fully considered all information on the subject available, they beg to report—

I. That from the statements obtained from the several Executive Engineers, the value of work which would probably be required from the Workshops (bearing in mind that in the vicinity of Calcutta iron beams will to a considerable extent supersede timber may be assumed as follows :—

Timber in scantling	... Rs.	1,00,000
House fittings, including doors, windows and such like	... „	1,25,000
Ironwork	... „	75,000
Total	.. „	3,00,000

One Member of the Committee, Mr. Bruce, considers that this amount should be increased to Rs 3,50,000.

II. That the cost of the work in the shops, exclusive of charges for fixed establishment, interest on capital, &c, would be in the case of—

Timber.—Two annas in the rupee less than the Presidency bazar rate.

House fittings.—Twenty-five per cent. less than the usual petty contractors' prices.

Smith's work.—Thirty per cent. less than the rates of European firms.

III. That taking these figures the actual cost of the work above mentioned would be—

	Actual cost, exclusive of general charges.	Available for general charges.	Total Rs.
Timber	87,500	12,500	1,00,000
House fittings ...	93,750	31,250	1,25,000
Ironwork	52,500	22,500	75,000
	2,33,750	66,250	3,00,000

or if the total be assumed at 3½ lakhs of rupees, the actual cost of work may be taken at Rs. 2,70,000, and the amount available for general charges at Rs. 80,000.

IV. That it would be requisite to establish a timber yard, a carpenter's shop, a fitting shop, a smith's shop and a small foundry.

V. That in addition to the establishment employed in the shops, which would be charged in the day-books to the actual cost of work, and which would fluctuate with the increase or decrease of work, it would be necessary to maintain a fixed establishment of a Superintendent two Foremen, two Assistant Foremen, and Office Clerks and Draughtsmen, the cost of which we assume at Rs 3,000 per month.

VI. That as regards the locality for a workshop for the department there are disadvantages connected with Sealdah. The carriage of unwrought timber and iron to the yard and carriage of the wrought material thence would, as compared with a more favourable site adjoining the river or Tolly's Nullah, involve a dead charge of not less than Rs. 4 per ton or say 4 per cent. on the outturn. If a landing and despatch agency is to form part of this establishment, and the Committee are of opinion that this might with advantage be done, it would then be a matter of necessity that the yard should be at Howrah and connected with the railway; and under any circumstances the Committee are of opinion that Howrah would be the best site for the workshops. As, however, the Government of India have especially referred to the buildings in connection with the Mutlah Railway, and there are reasons which would render it desirable, if possible, to utilize the capital represented by these buildings and machinery now lying idle, the Committee proceed to report—

VII. That the portion of the premises at Sealdah which would be most suitable for the purpose would be the plot coloured yellow on the accompanying plan, containing an area of about 14½ beegahs, and including the two blocks of buildings known as the "carriage and wagon shops," and "locomotive workshop," the former covering 22,400 superficial feet; the latter 13,500 superficial feet.

VIII. That assuming the value of land at Rs. 4,000 per beegah, and the buildings at Rs. 3 per superficial foot, the value of this portion of the property would be say Rs. 1,65,000,

Land ...	Rs	58,000
Building ...	„	1,07,700
Total ...	„	1,65,700

and to place the buildings in suitable order, including the provision of glazed lights and stone flooring, and to enclose the premises with a strong railing with an entrance, would involve an outlay of Rs. 40,000. It is understood that if the buildings referred to were made over to the Public Works Department, shed accommodation to the extent of 16,000 superficial feet would have to be provided for the railway in lieu thereof.

IX. That the value of the machinery required to fit up the shops in an efficient manner is roughly estimated at Rs. 1,00,000, of which one-half could be selected from that at present in store; the remainder, which would include chiefly that required for the carpenters' shop, would have to the procured from England. A supply of tools to the value of Rs. 15,000 would be necessary, and the fixing of the machinery, including shafting, would require an additional Rs. 10,000, thus making the total outlay under this head Rs. 1,25,000.

X. That it would be necessary to maintain a considerable stock of timber and metals; and as the issues of raw materials for the work indicated in clause III would be about 1¼ lakhs per annum, the value of stock; if carefully selected, might be limited to Rs. 2,00,000.

XI. From the foregoing, the Committee deduce the following as the probable financial result of the workshops, if established at Sealdah:—

CAPITAL REQUIRED.

Block.—Value of buildings and land ...	Rs.	1,65,000	Rs.
Do. of additional works .	„	40,000	2,05,000
Machinery—Value of machinery now in store	„	50,000	
Do. of additional machinery	„	75,000	1,25,000
Stock.—Value of purchases to be made	„	2,00,000	2,00,000
Total Capital	„	...	5 30,000

ANNUAL OUTLAY AND INCOME.

Actual outlay on manufacture ...	„	2,33,750
Depreciation of block, at 2 per cent. .	„	4,100
Ditto of machinery, at 15 per cent.	„	18,750
Establishment ...	„	36,000
Interest on capital, at 4 per cent.	„	21,200
Loss owing to position at Sealdah (*vide* clause VI)		6,000
Total outlay ...		3,19,800
Income from sales ...		3,00,000
Probable net loss ...		19,800

Or if the increased outturn of work, viz. 3½ lakhs of rupees, be assumed, the loss would be reduced to not more than Rs 6,000.

XII. The majority of the Committee. Messrs. Boyce and Isaac, are of opinion that, if the operations of the proposed workshops are to be confined merely to the manufacture of wood and ironwork for the ordinary requirements of the department, the establishment of such workshops will not be a profitable investment; and unless the advantages to be gained from them as a training school for subordinates can be proved to outweigh the probable monetary loss, they are inclined to think that the establishment of such workshops would be scarcely advisable.

XIII. It is true that Government have already incurred the greater portion of the outlay; and, taking the value of the land, buildings and machinery as previously noted, Rupees 2,15,000, and allowing for interest at 4 per cent., and for depreciation of machinery 10 per cent., there is an annual loss being at present incurred by this capital lying unemployed of not less than Rs. 13,600 so it is probable that the loss which would be incurred by the establishment of the workshops would not greatly exceed the loss which is now taking place. This, however. to the majority of the Committee would not be a sufficient reason to warrant further outlay.

XIV. In conclusion, the Committee would observe that, although they think that the establishment of Workshops merely to supply the present local requirement of the department in Bengal is not likely to be profitable, yet it is a question for consideration whether such workshops could not be profitably established with the joint object of meeting the present requirements of the department and the probable requirement of the State railways, including the landing and despatching of stores The Government has just inaugurated a vast scheme of State railways for which large quantities of rolling-stock will be required. The greater portion of the stock sent to Calcutta must be fitted and put together at Howrah before being despatched up-country. Although the Committee have nothing before them to enable them to pronounce an authoritative opinion as to the amount of work that will arise from this source, they are satisfied that, if the Government railways are prosecuted as proposed. the work of putting together and mounting the locomotives, carriages, and trucks will be very great, and that Government will probably find it profitable to execute such work in a workshop of their own.

XV. If such work could be secured for a department workshop in addition to the local requirements of the Public Works Department, and the workshop could be located on the river bank at Howrah, close to the railway, the Committee think that there can be no reasonable doubt that the establishment of such a workshop would be profitable and desirable in all respects.

No 3329, dated Calcutta, the 12th July 1870.

From—Col J. E T. Nicolls, R.E., Secretary to the Govt. of Bengal, P. W. D.,
To—The Secretary to the Government of India in the Public Works Dept.

With reference to the Under-Secretary's letter No. 52E.G., dated 10th January last, I am to state that the Lieutenant-Governor, being of opinion that there was no existing establishment of suitable character to give the practical instruction required for departmental officers and subordinates, and that the establishment of a "thoroughly efficient general mechanical (work) shop" was a question not to be decided without careful enquiry, thought it desirable to convene a Committee to report on the subject.

2. The Committee was composed in the first instance of H Leonard, Esq, C.E, Superintending Engineer, South-Eastern Circle; Major W. S. Trevor, V C. R.E, Superintending Engineer, Presidency Circle; F. R. Boyce, Esq., Controller of Public Works Accounts, Bengal; but the first two gentlemen having left the country before the preliminary investigations were concluded, it was necessary to remodel the Committee, which became as follows:—

F. R Boyce, Esq., Controller of Public Works Account, Bengal... *President.*
T. S. Isaac, Esq., C.E.. Offg. Supdg. Engr., Presidency Circle ... } *Members.*
W. D. Bruce, Esq., C.E., Exe. Engr, 2nd Presdy. Division ... }

3. The report of the Committee is now submitted, and it is stated that—

"The majority of the Committee, Messrs Boyce and Isaac, are of opinion that, if the operations of the proposed workshops are to be confined merely to the manufacture of wood and ironwork for the ordinary requirements of the department, the establishment of such workshops will not be a profitable investment."

4. It will be observed that this conclusion has been arrived at after making allowance, according to the rules regarding workshops, for charges for depreciation of block and machinery, and for interest on capital sunk, including two lakhs of rupees for timber. If these be set aside, it would appear that workshops would pay.

5. It is understood that the Committee in calculating the saving to be effected by establishing workshops contemplate the Superintendent engaging in operations beyond the mere workshop; for instance, that in the matter for timber he should purchase at distant marts if necessary to ensure cheapness, making his own arrangements for bringing the timber to Calcutta, and that he should for the sake of economy purchase in the log As is well known, such arrangements as these involve considerable risk, and require the best management and the closest scrutiny into every detail It is desirable that Government should avoid entering upon such arrangements if possible.

6. It is also understood that the calculations and work to be done have been based upon the averages of work done throughout Bengal during the last three years, considerable reductions being made from these averages. This is no more than prudent, because the increased use of iron for roofing and bridges will in all probability materially reduce workshop operations in Calcutta, and because the reduced budget grants and the completion or deferred progress of the large buildings at the Presidency will have the same effect.

7. As it is necessary that a paying workshop should have constant employment, the establishment should be fixed for the minimum amount of work likely to be done; but even then the daily work must be constant to the average of that minimum. This is a further reason for caution in accepting the averages unconditionally.

8 An establishment to carry out the ordinary average quantity of work might be retained were it allowable to do work for the public, but in the case of making bricks at Akra, the Government of India has already declared against the principle, and the Lieutenant-Governor does not think it desirable to enter into competition with the manufacturing firms of Calcutta. On the whole, the Lieutenant-Governor agrees with the majority of the Committee in not recommending a general mechanical shop such as is proposed

9. The Committee suggest, however, that though a workshop may not be profitable in connexion with the general requirements of the public works in Bengal, it might be so if combined with the arrangements for the State Railways in Northern India.

10. It is impossible to form any decided opinion on this subject in the absence of data of the business to be transacted, and whether the requirements of the railways would be permanent or likely to last any and what time, &c. It is obvious that Howrah would be an excellent situation for such a workshop, but a suitable site would probably be very expensive.

11. The Lieutenant-Governor is disposed to think that if a workshop is established at Howrah it should be primarily for railway purposes, and that the general work of the department should be merely regarded as an adjunct thereto.

12. So far this question has been considered as put in the letter under reply; but I am to remark that the intentions and wishes of this Government do not appear to have been understood. This Government wishes to give such practical training to the members of its engineering staff as would fit them to take up the ordinary duties required of them by Government at no long interval after theoretically qualifying for the department. The suggestions made in your office letter under reply do not appear to meet this requirement, and their probable result would seem to be merely to turn out a number of good mechanics. It is of course desirable that the members of this department should have some knowledge of machinery, foundry work, &c., but the extent of this knowledge should depend on grade and position, and whether such work is to be a special subject or not, what is

ordinarily wanted being to understand the subject generally. Mechanical knowledge is no doubt very valuable, but the great object at present is to have an establishment that possesses knowledge of good work of *all* descriptions, can manage work-people, can apply manual labour well,—in short, an establishment is wanted that can efficiently carry out the ordinary work of the department at out-of-the-way places by the means ready at hand, or readily procurable.

13. In his note of February 1868 Mr. Leonard contemplated instruction being given in ordinary divisions by means of special instructors, and he advocated a small workshop like the late iron bridge yard being established. This principle is the same as is now advocated, but there are differences in the way of working it. As shown in the Chief Engineer's note of the 30th September last, brick-making, brick-laying, building, machinery can be arranged for on Government works, or at a Government institution, *i.e.*, at the Cossipore Foundry or in the Dockyard; and what it seems necessary to provide by special means is instruction in the simpler operations of carpentry, joinery, and ironwork. For this general mechanical workshops are not required. Something simpler than what is apparently contemplated should suffice. But any arrangement would be futile without a staff to look after and superintend the instruction. A special superintendent of studies is, the Lieutenant-Governor thinks, of the first importance and essential to any scheme connected with the instruction of young men, particularly when, as in this case, the instruction has to be obtained in different ways and at different places.

14. To bring this matter to a practical conclusion. An opinion has already been given against the establishment of a general mechanical workshop, and were the necessity of establishing such shops promising, the Bengal Public Works Budget in its present reduced state could not provide the capital of Rs. 3,30,000 to be sunk in block and machinery alone, as proposed in paragraph 11 of the Committee's report. If the Bengal Budget is to be debited with the cost of the block and machinery at Sealdah, the idea of having workshops on any scale at that place should be abandoned, and the Lieutenant-Governor would revert to the site of Tolly's Nullah, as described in paragraph 27 of Chief Engineer's note of 30th September last. All that seems necessary in the way of workshops is to have a shop wherein a certain amount of superior manual labour shall be employed, and use made of some of the simpler machines for carpentry, joinery, and iron-work.

15. In the difference of opinion that seems to exist on this very important subject, the Lieutenant-Governor will not attempt any more definite scheme than has been brought forward with my No. 5670, dated 4th October last.

16 In conclusion, I am to state that this question is of the greatest importance. Continued experience only shows how very much the material interests of Government as well as the good name and efficiency of a large and important department suffer through having to entrust so much of its work to inexperienced, untrained agency.

CHAPTER II.

RELATIONS BETWEEN THE PRESIDENCY COLLEGE AND THE PUBLIC WORKS DEPARTMENT.

Memorandum by MR. SUTCLIFFE *for* COLONEL NICOLLS *on the Presidency College School of Engineering.*

THE accompanying statement shows the number of students on the rolls of the Engineering Department in the month of March during the last five years. It also shows the number of students who have left the college with certificates in various grades from 1865 to 1868. The examination for 1869 has not yet been held, but it is probable that a larger number of qualified candidates will be sent out during this year than for many years past. It will also be observed that, numerically, the department is now stronger than it has ever been since the amalgamation of the old college with the Presidency College, and there is every reason to believe that when the next session opens in June there will be not less than 100 students on the rolls. With very few exceptions, the students who have passed out of the college with certificates have found employment in the Department of Public Works. Occasionally employment has been found under the different municipalities that have lately sprung up, but doubtless the passed students look almost entirely for employment under Government, and must continue to do so. Indeed, I have no hesitation in saying that the Engineering Department might be closed at once if Government ceased to take into employment the passed students. Under the regulations of the old Civil Engineering College, Government guaranteed employment to a limited number of qualified students in the different grades annually.. This guarantee ceased on the amalgamation of the college with the Presidency College, and in lieu of it Government agreed to give five scholarships annually, each of Rs. 50 a month, to students who had passed the University examination for a license. These scholarships were to be tenable for two years, and during this time the licentiates were to be attached to different departments for the purpose of learning the practice of their profession. This plan was carried out last year in the case of two licentiates, but it did not work well, and in my opinion it never will work well, and the result was the two young men were passed into the service of Government as Engineer Apprentices even before they had drawn a rupee of their scholarship allowance. It would be much better to go back to the old plan of giving annually a limited number of appointments in the different grades to the final students who, after examination, are found qualified.

I wish you to understand from what I have said that the students look almost entirely to Government for employment when they leave college with the necessary certificates, and that, as a matter of fact, they have always hitherto found employment under Government. If Government ceased to employ the passed students, the college might be closed.

J. SUTCLIFFE.

PRESIDENCY COLLEGE,
The 15th March 1869.

APPENDIX A.

Statement of Professions of Guardians of Students attached to the Civil Engineer's Department, Presidency College.

Class	Number of the students on the roll.			Professions of Guardians
Third-year Class. 10 Students.	All Natives.		1	Writer on Rs. 50.
			2	Ditto „ 110.
			3	Pensioner „ 30.
			4	Zemindar „ 50.
			5	Ditto „ 120.
			6	Darogah, Salt Golahs, Rs. 40.
			7	Sub-Assistant Surgeon „ 150
			8	Writer, Rs. 50.
			9	Ditto „ 25.
			10	Indeppndent „ 50.
Second-year Class. 16 Students.	All Natives, except 2.		1	Writer on Rs. 30.
			2	Ditto „ 30.
			3	Farmer.
			4	Naib of zemindar.
			5	Writer, Rs 300, Office of Examiner of Claims.
			6	Ditto „ 80.
			7	Ditto „ 50.
			8	Commissariat Gomastah, Rs. 30.
			9	Absent.
			10	Deputy Magistrate, Rs. 300.
			11	Moonshee, College, Fort William.
			12	Farmer.
		Eurasian	13	Pensioner.
		European	14	Independent.
			15	Writer, Rs. 60.
			16	Ditto „ 150.
First-year Class. 52 Students.	All Natives, except 5 Eurasians and 3 Europeans.	Eurasian	1	Translator, High Court.
		Ditto	2	Merchant.
			3	Landlord.
			4	Independent.
			5	School-master, Rs. 20.
			6	Writer, Rs. 80.
			7	Absent.
			8	Writer, Rs. 90.
			9	Ditto „ 100.
			10	Landing Sircar, Rs. 20.
			11	Writer, Rs. 100.
			12	Shop-keeper.
			13	Absent.
			14	Ditto.
			15	Writer, Rs. 35.
			16	Sircar „ 20.
			17	Independent.
			18	Absent.
			19	Ditto.
			20	Pensioner, Rs. 25.
			21	School-master, Rs. 25 (private).
			22	Absent
			23	Native Physician.
			24	Absent.
			25	Shop-keeper.
			26	Petty land-holder.
			27	Ditto.
			28	Contractor.
			29	Coach-builder.
			30	Engineer, Rs. 400.
			31	Mooktear.
			32	Pleader, Sudder Ameen's Court, Pubna.
			33	Writer, Rs. 75.

Class.	Number of the students on the roll		Professions of Guardians.
First-year Class— (*continued.*)		34	Cash-keeper, Exchange.
		35	Absent.
		36	Salt Inspector, Rs. 150.
	Eurasian	37	Government Pensioner, Rs. 200.
	Ditto	38	Merchant.
		39	Twist Merchant.
		40	Petty Talookdar.
		41	Independent.
		42	Writer, Rs. 50, Paper Currency Department.
		43	Ditto „ 400, Financial Department.
	European	44	Captain, Government steamer, Rs. 350.
	Ditto	45	Hotel-keeper.
		46	Deputy Collector, Rs. 600.
		47	Translator, High Court.
	European	48	Pensioner.
		49	Native Physician.
		50	Twist Merchant
		51	Landing Sircar.
	Eurasian	52	Principal, Normal School, Benares.

APPENDIX B.

	Class	Civil Engineering Department, Presidency College											Remarks
		1865.		1866.		1867.		1868.		1869.			
		Europeans and Eurasians.	Natives.	Europeans and Eurasians	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.		
Number on the rolls at the end of the year ...	1st year	2	20	.	15	2	25	1	29	9	43		
	2nd „	5	11	2	12	...	7	...	13	2	14		
	3rd „	4	3	1	10	1	6	...	4	...	10		
Total ...	.....	11	34	3	37	3	38	1	46	11	67		The examination for 1869 has not yet been held, but there will be most probably a considerable increase over former years in the number of students found qualified for certificates.
Number passed out in each year	Assistant Engineer ...	1	...	2	2	1	6		4	..	.	16	
	Sub-Engineer .	1	...	1	..			...	...			5	
	Assistant Overseer .	...	...	..	8	1	2	...	5	...	2*	18	
	Sub-Overseer	.	..	...	.		..	...	1	...		1	
Total ..	..... .	2		6	10	2	8	.	10	...	2	40	

* Passed Department Public Works examination in February 1869

Presidency College,
The 15th March 1869.

J. Sutcliffe.

Note by Colonel J: E. T. Nicolls, R.E., *added in* 1875.

P. S.—I have endeavoured to bring the statistics contained in this note up to date.

Appendix C is Appendix B continued in 1875.

Appendix D is in continuation of Appendix A, and shows the profession of th guardians of students during the years 1871, 1872, and 1873.

Appendix E gives the information for 1873, 1874, and 1875 in a different form.

Paragraphs 1, 7, and 10 of the following note apply to the actual state of things at the present day; but it may be noted in regard to paragraph 6 that the course of engineering is so regulated as to qualify after one year for grade of Sub-Overseer, after two years for Overseer, and after three years for Assistant Engineer.

J. E. T. N.

APPENDIX C.

CIVIL ENGINEERING DEPARTMENT, PRESIDENCY COLLEGE.

	Class.	1865.		1866.		1867.		1868.		1869.		1870.		1871.		1872.		1873.		1874.		1875.		Grand Total.	Remarks
		Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.	Europeans and Eurasians.	Natives.		
Number on the rolls at the end of the year.	1st year	2	20	...	15	2	25	1	29	9	43	7	39	3	55	5	64	3	72	...	158	3	100	655	This return has been made up to 28th February 1875. *N.B.*—Those ex-students who failed, but subsequently passed the Department Public Works examination are also included in this return.
	2nd ,, ...	5	11	2	12	...	7	...	13	2	14	4	23	7	20	2	30	2	38	2	30	...	46	279	
	3rd ,, ...	4	3	1	10	1	6	...	4	...	10	2	9	5	13	4	11	1	19	2	20	1	11	143	
	Total ...	11	34	3	37	3	38	1	46	11	67	13	71	15	88	11	105	6	129	4	223	4	157	1,077	
Number passed out in each year.	Assistant Engineer	1	...	2	2	1	6	...	4	...	...	1	6	5	2	4	4	1	2	...	3	...†	...	44	* Passed Department Public Works examination in February 1869. † The result of the examinations for 1875 will not be known till the end of June.
	Sub-Engineer ..	1	...	4	...	...	...	...	...	...	...	4	...	6	..	1	...	1	...	7	.	...	...	24	
	Assistant Overseer	...	...	.	8	1	2	...	5	...	2*	..	6	...	3	.	1	...	7	...	7	...	4	46	
	Sub-Overseer .	...	...	...	..	...	...	...	1	...	...	...	8	...	6	...	3	...	...	...	15	...	...	33	
	Total ...	2	...	6	10	2	8	...	10	...	2	1	24	5	17	4	9	1	10	...	32	...	4	147	J. SUTCLIFFE. 3rd *April* 1875.

APPENDIX D.

Extract from Statement of Professions of Guardians of Students attached to the Civil Engineering Department, Presidency College.

Professions of Parents or Guardians.	Number of Students.			Remarks.
	1871.	1872.	1873.	
Writers on Rs. 50 and less	17	34	37	There is no memorandum of the professions of parents of students on the rolls in the years 1869 and 1870, consequently the number of students on the roll in those years has been omitted in this return.
Ditto ,, 110 ditto	20	5	9	
Pensioners ,, 30 ditto	4	12	7	
Small landholders with income of Rs. 50 ...	19	12	13	
Ditto ditto ,, 120 ...	4	4	11	
Darogahs, Salt Golah, on Rs. 40 ...	10	27	38	
Sub-Assistant Surgeons ,, 150 ...	26	16	13	
Independent	3	6	4	
Total ...	103	116	132	

APPENDIX E.

Return of social position of the Pupils in the Civil Engineering Department, Presidency College, ending 31st March 1875.

	Upper Class.			Middle Class.			Lower Class.			Parentage not ascertained.			Total.
	Hindoos.	Mahomedans.	Christians.	Hindoos.	Mahomedans.	Christians.	Hindoos.	Mahomedans.	Christians.	Hindoos.	Mahomedans.	Christians.	
3rd-year class	...	...	...	11	...	1	...	...	...	...	...	...	12
2nd ,, ,, ...	...	...	...	44	1	...	...	1	...	...	...	...	46
1st ,, ,, ...	...	..	...	96	...	2	...	...	...	...	...	1	99
Total ...	...	...	...	151	1	3	...	1	...	...	...	1	157

Note by COLONEL J. E. T. NICOLLS, R.E, *Secretary to the Government of Bengal, in the Public Works Department, on the relation between the Presidency Civil Engineering College and the Public Works Department, dated May* 1869.

MR. SUTCLIFFE'S memorandum and statement show generally the position of the Civil Engineering College since 1865

2. Almost all the passed students find service in Government employ, and the Principal states "if the Government ceased to employ the passed students, the college might be closed."

3. The exceptions to finding employment under Government consists of a few instances where employment has been obtained under the different municipalities (mofussil), and I believe that in one case the Tipperah Rajah applied for and obtained a passed student.

4. I could not learn from the college authorities of any passed student having been taken by contracting or professional firms European or native, by railway companies, or by private professional men of any sort, though there seem to be some few cases in which Europeans have found employment in the railway, and some natives have taken to contracts after failing in Government employ.

5. There is no test of character or respectability of any sort, the only qualification necessary for entering or passing out of the college being the capability of passing certain examinations.

6 In college there is no distinction between candidates for the higher and those for the lower grades: as long as the path is the same, all go on together.

7. There appears to be no distinction as regards social position between the native Assistant Engineers and the native Overseers. It is simply a question of perseverance and power of passing the examination test that decides whether a student shall occupy the superior position of Assistant Engineer, or the inferior one of Overseer, or even the still lower grade of Sub-Overseer

8. The accompanying statement (Appendix A) shows the social position of the present college students

9. The number of students in college from 1865 to 1868 appear to have been stationary on the whole, the number of natives having slightly increased, and the other students (European, Eurasian, &c.) having almost entirely ceased to come forward. During the present year there appears a large increase both of natives and others, and more are expected. The reason assigned is the prospect of employment on irrigation works.

10. It is curious to mark the falling off in the number of natives in each year of college life. The second year sees about half the students that studied during the first, and the third year sees but half of these, or one quarter of the original number. This falling off is ascribed to students getting the measure of their abilities and prospects and, not finding the chances of success great, giving up the contest; also to others going into life early, in which case they sometimes work on the knowledge they have obtained, qualify themselves, and come up for examination without re-entering the college, and so do not appear as though they owed anything to it.

11. Of 258 students in the college in the five years 1865 to 1869, 222 or $\frac{6}{7}$ appear to have been natives.

12. During the four years 1865 to 1868, 38 students passed out. Of these 28, say. $\frac{3}{4}$, were natives.

Of the 38 passed candidates—

16 or $\frac{1}{2}$ were Assistant-Engineers.	16 or $\frac{1}{2}$ were Overseers.
5 or $\frac{1}{8}$ were Sub-Engineers.	1 was a Sub-Overseer.

Of the 16 Assistant Engineers 12 or $\frac{3}{4}$ were natives.

There were no native Sub-Engineers.

There was only one European Overseer.

The Sub-Overseer was a native.

13. It may be gathered from these figures and from experience that—

1*st*—The non-native Overseer class of person will not go to college. If a man comes from Europe, he is probably too old to go to college, cannot take to book-work, or cannot afford to do so.

2*nd*—The non-native class will not take up the Sub-Engineer's examination, which is difficult, probably for the same reasons as above. There have been none of this class during the last two years, and the students of previous years seem to have gone to private employ, when they found that passing the test did not procure them immediate employment in the Sub-Engineer's grade.

3*rd*—There is a class of natives who, through want of means, ability, or application, are content with an Overseer's position.

4*th*—There is a certain number of natives who, feeling there is a prospect of better things, push on; and finding the Assistant Engineer's examination not very far beyond the Sub-Engineer's, set this aside and aspire to the greater prize, to strive for which it is only natural that the teachers should give every encouragement.

14 Judging from the names in the classified list of the Public Works Department, I gather that after passing college one or two Bengali Assistant Engineers have gone to the North-Western Provinces and Punjab, and a few more to the "minor Administrations," chiefly Central India, Oudh, and Burmah. Of the subordinates, some dozen have gone to the North-Western Provinces as Overseers, half a dozen to the Punjab, a dozen

and a half to the minor Administrations, principally Central India. The remainder, then, must have come to Bengal.

15. I may mention here that I had a little experience of the Bengali Assistant Engineers and Overseers just before I left Oudh, three or four having been sent up as a commencement. We were unfavourably impressed with them. They seemed wanting in resource and energy, and appeared unable to manage the hardier race with which they were brought in contact. They themselves were still more dissatisfied with their position. Foreigners, fresh from college and inexperienced, without command of the language, with difficulties to contend with, they felt out of place, and very much the same thing occurred as has taken place in Burmah; they became depressed and home-sick, got into disgrace, some I think resigned, and some were turned off. I do not think that any remain now.

16. It is to be observed that there are rather more Bengalis in the lower grades of the department in other Provinces than formerly. These are almost entirely in the minor Administrations and especially in the Central Provinces. It will be interesting to watch how these men get on.

17. As matters, then, stand at present, Bengal is the recipient of the greater number of native passed students of the Presidency College. This will be still more the case if disinclination to go to Burmah or elsewhere prevents any drafting off in other directions. Bengal seems, however, still more interested in the question than this, for any individuals that might get a footing in the department elsewhere, and could not remain, would probably be transferred to Bengal, as being the only alternative short of dispensing with their services.

18. Further, the reports of the qualified candidates go direct from the college to the Government of India, which disposes of them, and therefore, and for the reasons just given, the arrangements of the Government of India in regard to these men are of great importance to Bengal, both directly and indirectly. A clear understanding should consequently be come to on this subject.

19. The direct effects on us of the college and the course that may be followed by the Government of India lie in the number of students that can be, and may be, given direct to Bengal; or, in other words, whether the college can give us enough, or whether the Government of India may give us too many; and in remarking on this subject it will be desirable to separate the considerations connected with members of the Engineer establishment from those connected with the inferior grades. The former will be taken first.

ENGINEER ESTABLISHMENT.

20. In order to place this question on a proper footing it is necessary to consider first how many native Engineers there should be, and this can best be determined by settling what number of native Executive Engineers we could employ.

21. On the principle that Bengali Civil Engineers are not to be sent to countries to which they have a great aversion, Assam and Chittagong would be prohibited places. Natives also could certainly not at present be put in charge of the Presidency Divisions, nor could they have charge of the divisions in which there are large military garrisons, nor yet of some of the larger ordinary divisions. The divisions from which natives would thus be excluded are fully 21 out of 36, leaving a balance of 15 divisions in which natives might perhaps be employed. But under the peculiar circumstances of the department, and the relations which superiors and inferiors bear to each other therein, no European Overseer could be placed under a native Executive Engineer, and it would probably be an exception if an European Assistant Engineer worked well with a native Executive Engineer. It is also necessary that there should be a certain number of ordinary divisions for the European Executive Engineers who cannot undertake the more important charges, or who may be unable to bear up against going to unhealthy climates, to which, under the supposition, natives are not to be asked to go. For these reasons natives can only have a portion of the ordinary divisions, and perhaps four constitute the maximum number of divisions that could at present be contemplated as likely to be open to native Executive Engineers for some time; and half this number seems as many as should be given to natives, until experience is gained and their fitness for such charges is established. The proportion of Assistant to Executive Engineers being about half as many again, the native Engineer establishment, according to this calculation of four divisions, should consist of 10 members. But we have at present 18 native Engineers, so that our numbers are more than complete, and the men being young, and the climate their native one, vacancies are likely to be but few. It will thus be seen that no more native Assistant Engineers are wanted at present, that the college can more than furnish the supply, and that the Government of India may easily give too many.

Assam	3
Presidency . . .	4
Military	7
Others	7

Assistant Engineer,	1st grade	3
Ditto,	2nd ,, ...	9*
Ditto,	3rd ,, .	2
Apprentices	.. ...	4*

* One supernumerary in each of these grades is employed on local works.

22. This last contingency comes, however, more particularly under the head of the indirect effect of the Civil Engineering College and the arrangements of the Government of India on the department in Bengal. That Government is probably not likely to give us directly more than we want, but the possibility of this being done indirectly seems not small. Indeed, there is little else to be done with home-sick Bengalis, pleading distress and illness, than to post them to Bengal, unless the policy be adopted of requiring them

to do much the same that the European officer with whom they are theoretically on equal terms has to do, viz, to bear up against what is disagreeable, or to take leave, or furlough, or to invalid.

23. It will thus be seen that the progress of the Presidency College, though of Imperial importance in some respects, is of peculiar interest and importance to the Public Works of Bengal.

24. I have hitherto taken the circumstances as they stand. I will now turn to what can and should be done, and the first step is to consider the material that has to be worked with.

25 I have already alluded to particulars regarding the candidates who come up for employment in the higher and lower grades. The largest number of native students appear to be sons of writers on small salaries, petty landholders, merchants, and sircars, and from this class we may expect good paper-work in the department, but the great want of these men is practical ability and tact, and one great point to be arrived at—one of the principal points indeed—is to cultivate a tendency of this sort

26. It has also been already noticed that the *only* test which students who pass out of the Civil Engineering College have to meet is an intellectual one. A person applies, gets on the books, pays the fees, passes an examination, is reported qualified, and is admitted into the public service There is no enquiry into character, nor yet (except as regards Overseers) regarding physical fitness for the exposure and work of the department. It may be urged that the main point in admission to the department in England is the competitive examination; and that a health certificate is more necessary for a person who, as the English candidate, has to work in a foreign country than for a native. This is true so far; but still the question of health deserves attention in a native as well as in an European, though it may be in a less degree. Then as regards character. Assuming that the competitive examination, with the usual certificate of character, is sufficient for the English candidate, it is to be remarked that education in England up to the required standard practically restricts the candidates to those of a certain class, whilst it only requires a general glance over the statement of professions of parents and guardians of the students at the Civil Engineering College to show that in this country, where education is purposely made so cheap, there is practically no restriction. Under such circumstances, character is of more than usual, and indeed of the greatest, importance. No private firm or individual would place its affairs even in a slight degree in the hands of men of unknown character; and still the interests of private individuals would be less compromised than those of Government, as they can exercise a much closer watch and supervision, and act with more promptitude and effect in the interests of their concern than is the case with a Government officer, who has to establish by regular proof any complaint or opinion he may advance regarding the inefficiency of an individual.

27. This question of position and character seems to be one of serious moment. The Government necessarily places the greatest confidence in its local officers. Their duties being peculiar and professional, criticism has not the weight that it would have were the question undoubtedly within the power of the critic. Then, also, the acts of Public Works officers, though they may, and do, call for the general remark, do not press on individual interests like those of civil officers, the police, &c., and any failure is less likely to be brought home than in other departments.

28. The anomalies of our present system are curious and striking. Natives who have passed the Engineer test take the very subordinate position of Overseer. There are at the present moment four men qualified for the post of Assistant Engineer who occupy the position of Overseer. Again, we find one brother in the grade of Assistant Engineer, which it is found necessary to strengthen for the purpose of keeping a better control over the grade of Overseer, which is not sufficiently trustworthy, and in which another brother is. Can the mere fact of remaining longer in college, and getting a few more marks, make all the difference which should exist, and amongst Europeans does exist, between the two positions?

29. The class from whence the native portion of the department is drawn has already been noticed, and it will be observed that the same class supplies office clerks, Assistant Engineers, Overseers, and Sub-Overseers, and to this list may be added contractors. This is surely not a healthy state of things.

30. The above remarks have been made more especially with reference to natives, but I must add that they apply in some instances to others from the Civil Engineering College, as Europeans and Eurasians.

31. It has already been shown that circumstances as they stand require that some limit should be put to the admission of native members of the department, and the consideration of the material we have to deal with shows no reason for increasing the numbers On the contrary, taking the interests of natives (who, if in excess of a proper proportion, could not get due promotion) and of the department itself, it would be advantageous, as far as the General Branch of the department in Bengal is concerned, were the supply of native Assistant Engineers stopped, or at any rate discontinued for a time, until the numbers were reduced to the proper proportion; or if the admission of natives to the department were limited to a few exceptional cases, or to the Overseer class, for which, being under supervision, they are better suited, and where, from the exposure to climate to be undergone, it is a necessity in many cases to employ them.

32. It is a forcible commentary on the practical value of natives of Bengal as Engineers, and on the probability of turning them into useful Engineers, that no instances are known of college Engineer students being taken by railways, engineering firms, professional persons, firms, or private practitioners, though cases are known in which natives rejected from the department have taken contracts in many cases not with advantage to themselves or Government.

33. But besides such questions as the class from whence our native Engineers come, requiring references for character and certificates of health, &c., there are the great points of ensuring a greater, and indeed a competent, amount of practical knowledge, both in our Engineer and our Overseer applicants; of accustoming them to practical work; and of impressing upon them that active personal exertion is indispensable.

34. This great want has been already recognized by Government, which allows five scholarships, of Rs. 50 a month each for two years, to enable candidates for professional employment to acquire practical knowledge. The original intention was that of these two years' practical training, one should be devoted to the acquisition of ordinary engineering, as in building, &c.; six months were to be given to actual work in mechanical engineering, and the remainder to surveying. It was, however, found that attaching students to the Surveyor-General's Department was impracticable and useless. Expense was necessarily involved which the amount of the scholarship would not at all cover; but more than all the time was too short for the usual survey training, whilst what would be learnt being for special ends would be of little value in increasing the student's practical usefulness, for which the knowledge of surveying already gained at college, which is considerable, formed sufficient groundwork. A proposal has accordingly been submitted to divide the survey time between the other two subjects, practice in surveying not being specially provided for, but having a place, if connected with the other work on which the individual may be employed.

35. During the years that these scholarships have been available, but two have been taken up, and this occurred last year. The scholars were, however, almost immediately appointed Assistant Engineers by the Government of India, and the scheme has had no real trial.

36. Mr. Sutcliffe, the Principal of the Civil Engineering College is of opinion that the scheme never will work well; and whilst admitting that there are difficulties connected with it, and that we shall probably not get all that could be desired out of it as it at present stands, I do not see how the principle* involved of Government carrying out the practical training can be avoided, and the question seems to be what would be the best expression of this principle.

37. Assuming, then, that Government must carry out the practical training, it will be profitable to consider, in the first place, what our present arrangements are, and why they will not answer. The actual state of the case is succinctly stated in the following extract from the calendar of the Calcutta University:—

Civil Engineering Department.

Students are admissible to this department who have passed the University Entrance examination The entrance fee is Rs. 10 and the monthly tuition fee Rs. 5. There are two scholarships, each worth Rs. 10 a month, attached to this department, which were founded in memory of the late Major-General Forbes These scholarships are tenable for one year, and are awarded after the annual college examination in May to the most deserving students in the second-year class. Five Government scholarships, each worth Rs. 50 a month and tenable for two years, are available annually for students who pass the University examination for the license in civil engineering, or the degree of B. C. E Holders of these scholarships received practical training—(1) in the Government Survey Department for six months; (2) in the Government workshops for six months; (3) in Government works in progress for one year. Other students who pass the University examination, but for whom no scholarships are available, are allowed to go through the same course of practical training free of charge

38. It has already been remarked that the six months to be devoted to surveying is impracticable; or, if made practicable, would be likely to be useless as far as advantage in ordinary engineering is concerned. Then as regards the training in works. Such training is to be given by officers without time to spare from their ordinary duties for giving regular and formal instruction such as the candidates require. The so-called training must therefore very much consist of the pupils picking up what they can, and such an arrangement as this is not sufficient to give them practical qualification for the public service, or for engineering work generally. The case would be, I imagine, very much the same regarding workshops, though, from the nature of the work, the result is likely to be more favourable.

39. It may, however, be argued in regard to the present system that this is the usual practical training of Civil Engineers in England. But the cases are not similar. Setting aside the differences of race and of character, &c., it is to be remarked that in England the Civil Engineer candidate pays heavily for what will only prove a benefit if he applies, whilst here he is paid for doing what he would scarcely take up under such a risk as is run in England. At present in England a lad who intends to become an Engineer is articled for

* If private Engineers were to undertake the practical training, they would require premia, which would put a bar against most native or country candidates; and though such a test would have advantages, it would, I conceive, be so opposed to the general policy of making education cheap and granting scholarships, that I presume it is useless to bestow special attention to the matter.

three years to a Civil Engineer to whom a considerable premium is paid. During this period the novice has the *opportunity* of learning a good deal both in office and out-of doors; but whether he does so or not depends very much on himself, and it does not follow that he has received much practical training, though no doubt he gets some. This arrangement no doubt works very fairly in England. As regards private employ, a man's measure is soon taken; and as he does not get employment if not efficient, he does not remain if not up to the mark. As regards Government employ, the case is not so satisfactory; but still the Engineer has to do sufficiently well to get a good certificate, or his heavy premium is money thrown away. In this country the case is very different. The Government is bidding for youths to come forward. The terms are so easy that the sons of men low down on the social scale do compete for the best prizes, and, having passed their examinations, find their way made easy by a scholarship, leading at present, as a matter of course, to employment; and once employed, nothing but utter incompetency procures removal, and there are many degrees short of this which are disadvantageous to the public service.

40. We have, then, in this country at present no proper provision for giving practical training, and no test that a proper training of this sort has been given. Pupils, again, require a good deal of looking after and attention in regard to their business habits, the disposal of their time and their studies; and it is not every man that is capable of doing this: an Engineer may carry work very fairly, and still from want of time, or want of turn that way, be unable to train pupils properly. It seems to me that, if practical training is to be effectual, we must have special machinery to some extent, and therefore some increased cost, and rearrangement of some portion of our system. But even then the measure would be incomplete, unless Government would undeviatingly refuse to take any but trained candidates.

41. I would accordingly propose to create what may be called a Professorship of practical Engineering, the holder whereof should be in the position of an Executive Engineer in the Public Works Department, and so be duly responsible for the work he did. He should, in short, be head of a model division, which should consist of one or more large works, such as the large Presidency buildings, some large bridge, or similar important work. He should be assisted by a subordinate staff as necessary, and should teach practical construction, including management of work and of work-people, proper keeping of accounts, checking quantities, &c., and he should be responsible for the attendance and behaviour of his pupils. He should take the pupils from the Civil Engineering College in whatever grade they may have passed out, and employ and train them accordingly. He should also take practical workmen, and train them, giving them the eventual advantage of his certificate; and a certificate from him that a man was a thorough practical man, and could kept the usual accounts and measure up ordinary work should be sufficient qualification for employment in the lower grades of the department. The present scholarships might remain for the upper grades; practical workmen should be paid the value of their work; and the Overseer and Sub-Overseer class should receive subsistence allowance for such numbers as it may be thought desirable to keep in training for the department.

42. It might also be laid down as a rule, with the view of preventing any restriction on native or country Engineers, that satisfactory proof of having practically qualified under a private professional Engineer or firm would be accepted as regards the practical test for admission to Government employ.

SUBORDINATE NATIVE STAFF.

43. But little requires to be said regarding this class of native officers They are a necessity to a large extent in consequence of climate. They sadly want practical knowledge and training, but with a good superior staff and preliminary practical instruction much may be done.

44. I find that whilst Officiating Chief Engineer last year, Mr Leonard discussed the practical training of this class in a note, in which I most cordially concur, and his scheme will fit in to what I have proposed

45. There are, however, one or two points that I must notice in reference to the subject.

46. Mr. Leonard's remarks about the want of practical knowledge and efficiency in this class of men is not too strongly put. This want is one of our great drawbacks.

47. His remarks about Sub-Overseers are also most just. It has been my opinion from the time the change was made that the step was a false one. In setting aside darogahs, jemadars, or whatever the designation may have been, a valuable practical agency was done away with, without any adequate substitute being given, and the circumstances tending to develope practical knowledge have become worse since the measure was adopted, the introduction of the contract system having taken away such necessity as previously existed for the subordinates taking up the practical management of work.

48 I may here remark, in regard to the practical deficiencies of both Assistant Engineers and subordinates, that the instances of injury to Government interests from this cause, which have lately come to notice, render it imperative to make some change immediately. Either practical knowledge must be acquired by special training as now proposed, or there must be a large number of supernumeraries in the department, who can be kept at head-quarters until instructed and qualified, or perhaps both arrangements will be necessary to some extent. Most work in Bengal is detached, and such work as is not of this sort is generally of too much importance to entrust to a tyro. This remark will perhaps best explain the necessities of the case in a few words.

49. It is difficult to fix an exact limit for the number of native subordinates. At present, or on the 1st May 1869, out of 160 upper subordinates 95 of them are natives, and the proportion might be 100.

50. I would here remark that I have not proposed to guarantee any number of appointments, because I think that the Civil Engineering College should be an institution for supplying indigenous Engineers for the country generally, and something beyond a mere supplier of Government requirements, which guaranteeing its pupils Government employ would tend to make it. Such assistance also seems quite unnecessary—witness the large increase of students now taking place. If this increase is due to the prospect of increased Government employment, then it is evident that there is already sufficient inducement; if on the other hand the increase arises from causes unconnected with Government employment, anything, such as a guarantee, that would tend to bring students to look to, and depend upon, Government would be prejudicial. It has already been noticed that, as it is, the supply seems exceeding the Government demand; and if this is correct, Government ought not to do anything to increase the attractions of the college as dependant solely on itself. Again, the present state of things is advantageous to Government, which has no obligations beyond the scholarship, and can therefore select such of the candidates as are best; and it is also probably advantageous to the public because there will most likely be a number of disappointed candidates who, under the pressure of circumstances, will possibly feel called on to take a step which, without some such pressure, they would be unlikely to take, and will turn independent Engineers, as contractors or otherwise, and so tend to solve the question as to the capabilities of Bengali Engineers for practical work.

51. The question will also arise, from what has been previously said regarding the sole test for the higher grades being intellectual, whether it might not be desirable to form different departments in the Presidency Civil Engineering College, as is the case at Roorkee. Any such arrangement would be inconvenient in several ways. It would probably necessitate an increase to the educational staff, and the provision of additional buildings, and would no doubt be productive of additional expense. The question is one very much for the Educational Department; but I may remark that, as matters at present stand, I do not see any necessity for separation, as under the view which has been taken Government could select its men, and the advantages of competition and selection would be combined.

52. The present state of the case and the proposals in this note may be briefly stated as follows:—

That the Civil Engineering College gives an excellent theoretical education at a low cost for Engineers and Overseers, but the measures for imparting and ensuring practical knowledge before a candidate enters upon the practice of his profession are defective; that at present Government must be prepared to undertake the practical training of candidates, but that due opportunity should be given of acquiring this knowledge otherwise; that the best way of Government undertaking the practical training is to appoint a Professor for this special object, and to commit to him the construction of one or more important works, such as will afford him the means of imparting the required instruction, which he should do in all branches, both in-door and out-of-door; that a certain number of scholarships or other advantages whilst under instruction should be afforded to students of the different classes, but that other persons desirous of practical training should be admitted to instruction under certain rules, and engagement to do work, manual or otherwise, according to their class; and that in the lower grades a certificate of practical qualifications from the Professor should be sufficient, with good character, &c., to admit to Government employment without the usual theoretical tests.

That as far as Government employment is concerned, character and health should be considered, and candidates only be taken on probation after selection for character, health, and ability.

That the want of practical knowledge and efficiency is of great moment as far as the public interests are concerned.

That the Civil Engineering College can supply more candidates than the Government of Bengal requires.

That a limit should be put in the admission of native candidates in order to preserve a proper proportion with reference to European, until their capability for admission to the higher grades of the public service is established.

That the course adopted by the Government of India regarding Bengali Engineers and Overseers is of great importance to the department in Bengal, which might in consequence receive an undue number of native members.

J. E. T. Nicolls, *Col.*, R.E.,

Secretary to the Govt. of Bengal, in the Public Works Dept.

May 1869.

Note by COLLONEL J. E. T. NICOLLS, R.E., *Secretary to the Government of Bengal, in the Public Works Department, on the measures necessary for completing the education of the Students of the Civil Engineering College, Calcutta, as Engineers, dated April* 1875.

AT the request of the Lieutenant-Governor, I have been over the Civil Engineering College with Mr. Sutcliffe, the Principal.

2. The first matter for consideration is what are likely to be the public requirements for Engineers from this college, and can the college meet these requirements.

3. The passed students of the college have hitherto found employment under this Government in its Provincial and Irrigation Branches, and under other Governments, principally the minor Administrations, to which they have been posted by the Government of India

4. As this memorandum should not be delayed, I have not spent time in ascertaining the actual statistics of these appointments, nor perhaps is this necessary. During the past ten years the Department Public Works has attained to gigantic proportions in a very short space of time through the development of irrigation, and railway schemes, and statistics of the openings which thus became available would probably afford no great criterion of the openings to be expected in future.

5. It seems improbable that anything like the same amount of increase will recur, and if it does the employment which the Government of India is now bound to provide for a certain number of Royal Engineer officers and for the Cooper's Hill students, will considerably lessen the chances of employment as regards the pupils of the Indian civil engineering colleges

6. Some employment under other Governments may perhaps occasionally be found in future by the Government of India for the students of our Civil Engineering College, but it is quite possible, judging by the disinclination of Bengalis to go to other Provinces, and by the endeavours they make to get back to Bengal when they have obtained Government employment in this way, that there would be no great call for these students out of Bengal. Assam and Burmah would afford good and appropriate fields of employment for them, but there did exist, and does probably still exist, on the part of Bengali students a great aversion to go to those Provinces, though no doubt it is being modified by the changes which are taking place in the Bengali character.

7. Colonel Gulliver does not think the Bengali Engineers particularly suitable for irrigation works, and he would rather not have them.

8. As regards ourselves, I find that in 1868 out of 77 members of the Engineer establishment 18 were natives, and of the subordinates 95 out of 160. Taking the month of November 1873, when our establishments had not been upset by additions for relief purposes, I find that we had 16 native Engineers out of a total of 68, and 101 native upper subordinates out of 150 As regards the Engineer establishment, the proportion is identical in both cases. This is owing to some of the native officers having been transferred to the Irrigation Department, and so made room for the additions subsequently made. As regards the subordinates, both the proportion and the actual numbers have increased, showing that we have been augmenting the native element at the expense of the European. Here again there was a considerable decrease, owing to the establishment of the Irrigation Department, followed by an augmentation owing to the introduction of the district system. It is necessary to note these circumstances, because, whilst it may be said that hitherto the Civil Engineering College students have actually found employment in the Government service, it should be remembered that this is due to exceptional circumstances.

9. It seems to me that owing to the abnormal increases already noticed, statistics have but little specific value, and are mainly of use by showing in a general way the causes that have brought about the results shown.

10 At the present moment we are in excess of our numbers, and we must absorb our supernumeraries before we can take in new applicants. But taking a favourable view of the case by setting aside this circumstance, and supposing that we had only our proper numbers, I think that there is no chance of the Provincial establishments alone being able to provide employment for all the Civil Engineering College students.

11. We must keep Europeans as the majority of our Engineer establishment, and at present I am not prepared to say that the proportion of natives to Europeans should be increased beyond that at present existing, and assuming then the strength of our Engineer establishment to be about, as at present, say 70, we should have a strength of, say, 16 natives, as is the case now.

12. These are young, and many of them hale, men, from whom but little in the way of diminution of numbers is to be expected from invaliding or death. The resignations, retirements, or cases of misconduct involving removal from the service of Government amongst this class are not frequent, and the prospect of openings amongst them is small, save by altering the proportion of natives to Europeans, or by augmentations, neither of which contingencies seem likely to happen.

13. The case is somewhat similar, though better, as regards the native subordinates There are older men amongst them; they are more exposed to vicissitudo of climate and accident; cases of resignations, retirement, or misconduct and failure involving removal from the Government service are not unfrequent; the numbers are much larger. Altogether the prospects of vacancies on this class are much better, but the class has been much increased of

late years, and a number of its members must be young. At present we have about 100 native upper subordinates, and shall probably have less; but assuming this number, 10 per cent. would perhaps be a good annual average of vacancies. This average might also perhaps be taken for the lower subordinates.

14. If the views above expressed are correct, then the *maximum* annual supply required from the Presidency College for Bengal Provincial works would be an Assistant Engineer occasionally, and 10 upper and 10 lower subordinates—a very limited demand, which would not of itself justify the retention of a large educational institution.

15. There is another avenue of employment which is now opening out—in the establishments required by the District Committees—and regarding the prospects of which His Honor requires information.

16. No sort of particular information can be given regarding what the numbers of these establishments are likely to be, for as yet none of them have been really organized.

17. There are some 44 districts in Bengal, and there will be a maximum expenditure of Rs. 40,00,000 on district works. There are also the mofussil municipalities Perhaps we might take 35 Engineers, 80 of the upper and 100 of the lower subordinate class as the numbers that will be required; and the eventual annual percentages of vacancies, supposing such a service to have been organized, may perhaps be taken as 1½, 8 and 10 for the several classes respectively, and these would be open to applicants from all quarters.

18. But these figures are of small immediate practical value. Some of the districts will require their establishments at once; some next year; some the year after, and all before 1877-78, by which period the cesses should be all leviable, and the district works should be fully constituted and in operation. It will thus be evident that most of the requirements of the districts are immediate, and none are distant. They will therefore require Engineers and a certain number of subordinates of some experience and practical knowledge at the very beginning, and the college will consequently be unable to supply the immediate wants of the districts, which will then have to be met in other ways; so that by the time that college students with some practical knowledge could be supplied, the district establishments would be mostly all organized, and after that the vacancies would be few, as already remarked. It is not known what the Committees will do regarding their establishments: some will no doubt take back the men they had formerly; some will wish to take outsiders, to whom, if qualified, objection can scarcely be made; some will take Public Works Department men. But from whatever source they get their men, they will not be old or likely to make immediate vacancies, except those who are taken from the Public Works Department, who will look for the promotion and increased salaries which those they have left behind in the department will be getting, and after a time there will probably be openings for new hands in this way. The prospects of providing for Civil Engineering College students on district works is but small at present, and, as far as present prospects show will not be very great hereafter.

19. Those who pass through the Civil Engineering College ought to have much brighter prospects than what has been sketched out in the foregoing paragraphs. An institution of this sort should exercise a larger influence than the college does now. It should be capable of more than merely turning out a number of young men who can satisfy the theoretical tests for Government employ. We ought to find it doing something towards aiding the private engineering enterprizes of the country; but I believe that it does little or nothing beyond supplying a small portion of the native contractors, from amongst those who have been dismissed from Government employ, or have been unable to obtain that employ through having failed in their college course. I have not heard, nor can the Principal of the college tell me, of any students being employed in private firms or railway workshops.

20. The cause of this is perhaps not far to seek. Mercantile concerns want only effective hands, and if they take a person who does not know his work, they require a premium for teaching him. Also, they look to practical efficiency rather than theoretical knowledge, though not under-valuing the latter if combined with the former.

21. The Government system is the very opposite of this. Here a theoretical test is all that is indispensable. Having obtained this, an applicant enters the department, and practical knowledge is acquired to a greater or less degree according to the man, and according to the circumstances into which he is thrown; but in any case it is obtained at the cost of the State.

22. It is not to be expected that the passed college men will seek private, when they can get Government, employ, especially where the conditions are such as have been noticed.

23. A Civil Engineer's training is not complete unless there is a certain amount of practical training, and this is the case from whatever point of view the question is regarded; whether it be making the student fit for the Government or for private employ, or to expand the number of contractors. This remark may with propriety be called a truism. Still it is not only necessary to make it, but to enforce it, for our Government system does not completely recognize it in such instances as that of this college.

24. I have long seen the very great necessity that exists for insisting on this practical training; and early in 1869 I submitted a note* on the subject to the then Lieutenant-Governor, but I received it back without orders on His Honour vacating office. I proceeded on furlough myself immediately after, and the matter dropped until my return, when the pressure of the relief measures and other matters prevented my moving further in the matter.

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25. Parts of the above note are obsolete; but they may perhaps be of interest, and I annex the whole note, extracting here the last paragraph, which briefly reviews the proposals made:—

"The present state of the case and the proposals in this note may be briefly stated as follows:—

"That the Civil Engineering College gives an excellent theoretical education at a low cost for Engineers and Overseers, but the measures for imparting and ensuring practical knowledge before a candidate enters upon the practice of his profession are defective; that at present Government must be prepared to take the practical training of candidates, but that due opportunity should be given of acquiring this knowledge otherwise; that the best way of Government undertaking the practical training is to appoint a Professor for this special object, and to commit to him the construction of one or more important works, such as will afford him the means of imparting the required instruction, which he should do in all branches, both in-door and out-of-door; that a certain number of scholarships or other advantages whilst under instruction should be afforded to students of the different classes, but that other persons desirous of practical training should be admitted to instruction under certain rules, and engagement to do work, manual or otherwise, according to their class; and that in the lower grades a certificate of practical qualifications from the Professor should be sufficient, with good character, &c., to admit to Government employment without the usual theoretical tests.

"That as far as Government employment is concerned, character and health should be considered, and candidates only be taken on probation after selection for character, health, and ability.

"That the want of practical knowledge and efficiency is of great moment as far as the public interests are concerned.

"That the Civil Engineering College can supply more candidates than the Government of Bengal requires.

"That the limit should be put in the admission of native candidates, in order to preserve a proper proportion with reference to European, until their capability for admission to the higher grades of the public service is established.

"That the course adopted by the Government of India regarding Bengali Engineers and Overseers is of great importance to the department in Bengal, which might in consequence receive an undue number of native members."

26. Further consideration does not lead me to make any modifications of moment in the views thus expressed, and as the Lieutenant-Governor has specially enquired how far the Civil Engineering College affords the means of meeting the annual requirements for Engineers, I may say that now as then, and so far as it goes, the institution seems capable of turning out the men that are likely to be required.

27. The question of practical training for the lower grades having been brought forward by the Government of India, I recorded a second note shortly after the above showing how the general principles advocated in the previous note could be carried out. Placing mechanical knowledge in a secondary place, I advocated the appointment of a Professor, Assistant Professor and four Instructors in practical works, who should have charge of a model division of Public Works, which should include carpenters' and blacksmiths' shops for the execution of such work for the department generally, the Akra Brick Factory and the ordinary operations of a Public Works Division affording the means of giving practical instruction in other branches of ordinary Engineering. A certain amount of mechanical knowledge was to be obtained at the Mint, Cossipore, or elsewhere, as convenient. The Professor and his staff were to look after the young men thoroughly, both as regards habits and progress. I do not see what better can be done now than to carry out this scheme, subject to some alteration in detail.

28. To this proposal the Government of India objected, as it was considered that what was done should be on "the basis of thoroughly efficient general mechanical shops," which included the workshops being a thoroughly paying concern. A committee was then formed, and reported that a workshop could be formed* and conducted on mercantile principles at a cost of Rs. 19,000 per annum.

* This report could not be adopted now, as the buildings it alluded to have been otherwise appropriated.

29. Their report was not supported by this Government, which wished merely "to give such practical training to the members of its engineering staff as would fit them to take up the ordinary duties required of them by Government at no long interval after theoretically qualifying for the department." Less mechanical training, that was contemplated by the Committee, was stated to be desired The matter then dropped.

30. It seems to me that a proposal for giving practical instruction to our young Engineer candidates should not be entirely gauged by the mercantile standard of whether the arrangement can be made to pay or not. Such practical training as is given must be effected by means of useful works, or the cost would be greater than could be borne for purposes of education; but there seems no more reason why the practical teaching of the candidates should be a paying arrangement than that the theoretical teaching at present given should be so. But looking at the question in the mere mercantile way of obtaining an adequate return for the outlay, I feel very certain that the arrangement would really be remunerative. Government would save more by not having to pay for the experience gained at its expense in consequence of the want of practical knowledge in its junior servants, than it would lose if the debit and credit accounts of the practical instruction scheme should show a loss.

31. Since the greater part of the foregoing remarks were written I have seen Colonel Gulliver's note of the 10th August last, with accompaniments, on the Dehree Training School. This is purely a mechanical workshop, where young boys are apprenticed for five years for thorough mechanical training. This is not what we want: we do not require such an amount of mechanical knowledge, and it is noted in the papers regarding the Dehree School that in order to produce efficient departmental Overseers it would be necessary to depute the boys to various works in order to learn the different branches of the profession, very much as I have proposed in certain instances. I observe also that there were numerous applications to

enter these workshops—no less than 383 from Europeans and Eurasians; but the natives do not at all take to them, the manual labour being disliked. Whilst this is to be said of Dehree, I may state that the four Civil Engineering College scholarship-holders—one Eurasian and three Natives—who have been sent down to the Akra Brick Factory, have all shown the practical nature of their instruction by making bricks in my presence. I should not ask for anything more.

32 It would no doubt be possible to obtain some portion of the instruction I propose at the Dehree or the Cuttack Workshops did other circumstances admit thereof; but it seems to me that these institutions are too distant from Calcutta. They could only be of use if Government took up the expensive measure of undertaking to give practical education to all the young men, which is what should be avoided if possible.

33 In my opinion the object to be aimed at is to make our engineering education such as would turn out young men of some immediate practical value, and to lead them to look otherwise than merely to Government for employment. Government should have the pick of the students, and employment in Government service should be the prize to be looked for by the few most deserving. Whether such an impress can really be given to our engineering education seems doubtful; but it should be tried. It will be a crucial test, and if unsuccessful I am disposed to think that some radical change in the system of educating Engineers must be made, for apparently the Government cannot undertake to provide employment for such a number of students as would justify its maintaining an expensive professional education staff for their education. Perhaps no more should be professed than to turn out Overseers and Sub-Overseers by special classes engrafted on the ordinary classes, Engineer appointments being restricted to cases of special merit, and to those of sufficient good social position to be able to pay for special instruction

34. I have not attempted to work this matter out in detail, as this would require time, and I should like to have His Honour's views before entering upon such a consideration.

J. E. T. Nicolls, *Col.*, R.E.,

Secretary to the Govt. of Bengal, in the Public Works Dept.

The 1st April 1875.

Memorandum by Bholanath Doss, C.E., *an ex-student of the Calcutta Civil Engineering College, on the causes of the decline of the College,—dated Dhubri, the 5th February* 1876.

The decline of the Civil Engineering Department of the Calcutta Presidency College, as noticed by His Honour the Lieutenant-Governor, may be traced to causes both of a general and a particular nature. (1) The withdrawal of the Government guarantee for finding employment to certain passed students; (2) the extension of the term of their training by two years, (3) limited field for their employment; (4) preference given to practical men to passed students of the college in the disposal of appointments in the Public Works Department; (5) slow promotion in the department—these are general causes. For particular, or rather the immediate, cause we should look to the students themselves, their preliminary education, and the subsequent training they receive in the college. To turn out a successful Engineer the theories and their ready application to practice should be learned together; but the present curriculum of studies is not sufficient to teach the young idea how to shoot forth in future years

2. As to the general causes. With the establishment of the college in 1857, the Government of India guaranteed employment to the native students, who would pass out of the college yearly to the following extent:—

(*a*) Three appointments in the Engineer grade with salary from Rs. 100 to Rs. 200.
(*b*) Eight appointments in the upper subordinate grade with a salary of Rs. 60.
(*c*) Thirty appointments as Sub-Overseers.

The encouragement thus afforded to the students, who would pass out to deserve these appointments, produced such a salutary effect, with the students having a scientific turn of mind, as to muster strength towards the focus of emolument—many had their scholarship, transferred from the colleges of general education, and the very best student of the Presidency College did not hesitate to throw away his metaphysics and law for the exact sciences. This circumstance could not possibly have been countenanced by the heads of the colleges of general education; and the subsequent amalgamation of the Civil Engineering with the Presidency College in 1864, or rather its reduction from a position of rivalry to one of subordination, was a sad mistake. It is from this date that the Civil Engineering College began to indicate signs of decline. The Government guarantee was subsequently withdrawn and five exhibitions, of Rs. 50 a month each, founded to award to the first five of the students who would pass the final examination successfully. These scholarships are tenable for two years, and are enjoyed by the students, on condition that they would undergo a practical training at the Presidency before they are eligible for

appointment in the Public Works Department. This arrangement, extended *de facto* the term of their education from three to five years, and placed the students to a disadvantage, by thus losing two of the best years of their lives with the view of reducing the theories, what may be technically called, to practice. If in England a term of three years be found sufficient to train an Engineer for practical purpose; if at Roorkee even two years' training is all that a student has to undergo to come out as an Engineer, it is not clear why the Calcutta student should take a longer period to qualify himself for a similar appointment It cannot be that the Bengalis are so slow in acquiring a scientific education that they would take five years, while the *alumni* of the sister college in the North-West Provinces, placed however under a peculiar climatic influence, would take only two. But the defect in the system of education imparted, and the want of interest shown, to the students of the Calcutta College have greatly to account for this difference The Roorkee College has, however, the advantage in the selection of its students as regards preliminary education.

3. The usefulness of engineering as a profession is not so well understood in India as it is in England, inasmuch as the private enterprises to which it gives birth are scarcely recognized here. The native Engineer has therefore to look upon the Government for a field to display his energies, and bear the fruits of his education. In England, engineering, like medicine, is considered to be one of the useful professions, there being an equal demand for both in daily life. In the advertisement columns of *The Builder* we find that every work—whether large or small—whether private or Government—is open to public competition, thus affording a scope, far and wide, for private and independent practice The case, however, is quite different in this country, where the people, one and all, pretend to have some knowledge of the art of building so as not to feel the necessity of calling to their aid an Engineer for the works he may require. Hence it is evident to what extent an Indian Engineer is likely to succeed if he is to practise on his own account. The times are, however, changed with the introduction of Western ideas and civilization, and our Engineers may hope to see better days hereafter. But to bring on this innovation at an earlier date it is desirable that some concessions should be made by the Government for the sake of the science, if not for the present generation of Engineers. Instead therefore of withdrawing the advantages at first conceded to them, it is necessary that the Government should hold out to the students better prospects of appointments, promotion, and position in the service, so as to stimulate their exertions towards the aim sought for.

4. The passed students of the college should have preference given them to outsiders seeking employment in the Public Works Department. The departmental heads look upon the latter as a set of practical men, better fitted for the immediate requirements of the service; but if the engineering students are fortunate enough to combine a sufficient practical with their theoretical knowledge, they can prove to a certainty that they are still better fitted for the service and for the profession generally. It is therefore absolutely necessary that the course of studies should be both of a theoretical and practical nature. There can be no question whatever as to the fact that all scientific studies should be illustrated by actual experiments and not by diagrams on the black-board; and much of the success of the Calcutta Medical College is due to this. It is utterly useless to have a mass of facts, obtainable from books, committed to memory without knowing however how to use them The student reads the descriptions of the various machines in his text-book, and learns the denominations of the several parts and their respective functions; but when he is called upon to handle any of them, he is at once placed in a false position to show how imperfect his knowledge of the machinery is.

5. The Government of India does not seem to observe any distinction of caste, creed, or colour in the bestowal of patronage; and the best appointments are alike open to both European and native members of the service. Hence it is only desirable that the native members should grow in number, and prove their usefulness, so as to vie with their European brethren.

6. Among the particular causes of failure, I must say that it is advisable for a scientific profession like the engineering that the student should acquire a thorough knowledge of English, and form a decision of character, before he begins his scholastic career as an Engineer. The qualification prescribed for admission into the college is indeed low to meet this requirement As in law and medicine so in civil engineering, none may be hereafter allowed admission until he shall have passed the first examination in Arts. By this arrangement the student, comparatively more advanced in mathematics, as he should be, as a matter of course, will be able to devote more of his time to the professional subjects which he has to begin anew. It may be noted that the admissions annually should be restricted to a number—say 40.

7. The course of studies (*vide* P. W. old Code, Appendix B., pp. 86 to 106) as originally adopted in the college appears to be sufficient, with slight modifications, for practical purposes. But it will be only necessary to introduce an experimental system of education as recommended in paragraph 4. Advantage should be taken of the workshops and yards in and near Calcutta to the fullest extent to illustrate the instructions given within the college walls. Furthermore, a small laboratory should be maintained to assist in the study of engineering and physical sciences.

8. To carry out these suggestions it will be necessary in the first place to detach the Civil Engineering from the Presidency College and give it a *habitat* of its own, under the immediate supervision of a professional gentleman as Principal. The advantages of having such a Principal are so obvious that I need hardly adduce any argument in support of my proposal. The past history of the college will bear me out.

9. To aid the Principal in the due discharge of the trust bestowed on him, I would suggest that the instructive staff of the college should consist of :—

1 Professor of Mathematics.
1 Junior Professor of Engineering (the Principal being the *ex-officio* Senior Professor).
1 Professor of Constructive Designs and Surveying.
1 Professor of Drawing in all its branches.
1 Professor of Physical Sciences.

The Junior Professor of Engineering, and the Professor of Constructive Designs and Surveying, may be selected from among officers of the experience of an Executive Engineer, fourth grade. The cost of entertaining this establishment will not be certainly more, if not less, than that of the other colleges with which the Calcutta College has to compete. The Cooper's Hill has Colonel Chesney for its Principal, and the Institution at Roorkee is superintended by an officer of Major Lang's position and reputation. To do justice therefore to the Calcutta College, I think an officer of the rank of at least an Executive Engineer, first grade, had better be appointed as its Principal

10. The remedies suggested may be briefly stated as follow :—

(*a*) A thorough reorganization of the college, both as regards its staff of teachers and teachable subjects.
(*b*) Enforcement of a higher standard of qualification for admission to the college extended to a fixed number of pupils annually.
(*c*) Restoration of the Government guarantee for appointments.

11. In conclusion, I beg leave to invite His Honour's attention to the remarks made by Major A. M. Lang, R.E, in the last annual report of the Thomason College, quoted below :—

"In the Engineer class 18 have gained their certificates as Assistant Engineers, and will, I hope, before long obtain appointments, although only 8 of them can at once claim guaranteed employments; and as the establishment of most provinces and departments appear to be at present overstocked, and the large number of assistants on their way to India from Cooper's Hill must receive appointments before the unguaranteed 10 men from this college, these latter may have some time to wait before employment can be secured for them This is unfortunate, not only as regards delay in commencing their career, the path of promotion and the receipt of pay, but also the risk of their failing to keep up the professional acquirements they have gained here, just at the time when it is most necessary to consolidate these, and when the young passed student, fresh from his books and his first interest in new branches of learning, is most ready to pick up and assimilate technical knowledge."

What Major Lang urged on behalf of Roorkee is also equally applicable to the Calcutta College. It may be incidentally mentioned here that the passed students of the college should have a considerable share in the appointments disposed of in the accounts branch of the Public Works Department (*vide* Public Works Code, Chapter II, Section V, paragraph 2, and Chapter II, Section III, paragraph 2) and in the road cess and other local funds departments. Of the several appointments lately made for road cess works in Bengal, only three have been conferred, as far as I am aware of, on the ex-students of the College.

BHOLANATH DOSS, C.E.,

Ex-student of the Calcutta Civil Engineering College.

No. 161E.

Extract from the proceedings of the Hon'ble the Lieutenant-Governor of Bengal in the Public Works Department (Establishment), under date the 30th January 1878.

READ—

Resolution of the General (Education) Department of this Government, No. 43 of the 4th January 1878, on the general report on public instruction for the year 1876-77.

RESOLUTION.—For some years past the necessity of giving practical training to the students of the Civil Engineering Department of the Presidency College has been admitted, and has been discussed by the Governments of India and of Bengal. The subject of technical education has of late received additional attention from the Government of Bengal. Not only have there been the college students to consider, but a portion of the native community has shown an unmistakeable desire to obtain the means of acquiring practical instruction and knowledge of engineering and mechanics.

2. A system of giving to natives a certain amount of technical instruction in the forge, carpenter's shop and brickyard, has for nearly two years past been established under the supervision of the Department of Public Works. The workshops of the 1st Calcutta Division and the Akra brickyard have been used for this purpose, and a number of young men have commenced their training as practical Engineers under the instruction of officers specially

selected for this duty. At first the instruction was confined to passed students of the Civil Engineering Department of the Presidency College who held scholarships for the purpose; but latterly a considerable number of passed students, who were not scholarship-holders, have asked and obtained permission to join the departmental workshops for instruction in various branches of work at their own expense. Both the stipendiary and non-stipendiary students have taken up their duties in the workshops with considerable earnestness, acquiring practical training by working with their own hands

3 Hitherto the small existing workshop of the Department of Public Works has been provisionally used as a means of helping on an important end, which circumstances did not allow to be taken up in a more effective manner. But the Lieutenant-Governor has lately determined to establish technical scholarships in various parts of the country in connexion with certain selected schools, and to establish the means of affording thorough technical training to a certain number of those young men who desire to adopt one of the branches of engineering as a profession.

4. The instruction hitherto given has been purely provisional and tentative, but it has established two facts—*first*, that there is a demand for instruction of this description; and *secondly*, that young natives of good family and position are perfectly willing to work with their hands, and receive instruction precisely as European apprentices would The necessity of providing for the middle classes the means of adopting some career and some calling in life more calculated to meet their ambition than the limited range of employment now open to them is daily becoming more thoroughly recognized both by Government and native society. It is impossible, however, to establish any great number of technical schools throughout the country, and they must be so situated that they shall be in connection with some workshops entrusted with real work to do, having a good stock of machinery and appliances, and a staff of able and expensive instructors. The attempts to establish independent technical schools have broken down from the impossibility of giving them a practical shape where they are not in connection with good independent workshops. The Lieutenant-Governor has therefore determined to establish technical scholarships in connection with selected schools: such scholarships will be held at technical schools established in connection with Government workshops.

5. Two centres will be sufficient for this purpose at present, though possibly a few scholarships may eventually be attached to railway workshops either of the State Railways or of the guaranteed lines in the event of the Directors and Agents of those lines being willing to receive apprentices. One centre has already been established at Dehree in Behar, where a number of young men have been trained, and on completion of their training have readily found employment in various parts of the country. Measures have been taken to expand this centre and make it available for larger numbers. The other centre should be in Calcutta, and to attain its object it should be constituted on a well considered basis. The necessity for constructing new workshops at the Presidency makes it a convenient time to take up the subject with reference to their situation and size.

6 The Lieutenant-Governor has accordingly appointed the following gentlemen to form a committee for the purpose of considering and reporting what measures are necessary or desirable to establish a practical training institution for Engineers, taking as a nucleus the workshops and manufactories of the Public Works Department at the Presidency, and on what scale the establishment should be formed:—

Major-General J E. T Nicolls, R.E.	*President.*
The Hon'ble H. J. Reynolds, C.S.	*Members*
A. W. Croft. Esq.	
Colonel F. T. Haig, R E.	
T S Isaac, Esq.	
Baboo Bhudeb Chunder Mookerjee	

7. The Lieutenant-Governor has reason to hope that a benevolent native nobleman, much interested in the development of fresh spheres of action for his countrymen in the upper and middle classes, will erect a college for the accommodation of mofussil students in connection with the institution as soon as it is established. Others would no doubt follow his example, and probably many local scholarships would be established by local beneficence in the various districts of Bengal. The Lieutenant-Governor also hopes to be able to establish scholarships for European and Eurasian lads in connection with these schools, and separate barracks would have to be built for them. In selecting a site therefore for the new workshop, the possibility of its largely increasing its scope and number of pupils should be borne in mind.

8. The Committee should also consider whether it would be desirable to remove the Civil Engineering branch of the Presidency College to the neighbourhood of the practical training school, so as to work the two together as one institution for giving a comdlete technical education and training for Engineers

ORDER.—Ordered that a copy of this Resolution be forwarded for the information and guidance of the President and each Member of the Committee

Ordered also that a copy of this Resolution be forwarded to the Education and Financial Departments of this Government for information.

Ordered also that a copy of this Resolution be published in the Supplement to the *Calcutta Gazette* for general information.

By order of the Lieutenant-Governor of Bengal,

J. E T. NICOLLS, *Major-General*, R.E.,

Secretary to the Govt. of Bengal, in the Public Works Dept.

CHAPTER III.

INDUSRIAL SCHOOL.

No. 2030R., dated Simla, the 24th May 1878.

From—The Secretary to the Govt. of India, Public Works Department,
To—The Secretary to the Government of Bengal, General Department.

As the question of the establishment of training and industrial schools for the children of State Railway employés is under the consideration of the Government of India preparatory to discussion at the Railway Conference, I am directed to request that the Government of India may be favoured with particulars of what is being done in Bengal towards the establishment of industrial schools.

No. 504T., dated Darjeeling, the 11th June 1878.

Memo by—A. MACKENZIE, Esq., Secretary to the Govt of Bengal, General Dept.

COPY forwarded to the Director of Public Instruction, with the request that he will favour the Lieutenant-Governor with a very early report on the subject.

No. 6752T., dated Darjeeling, the 31st October 1878.

From—A. W CROFT, Esq, M.A., Director of Public Instruction,
To—The Secretary to the Government of Bengal, General Department.

WITH reference to your letter No. 504T., dated 11th June 1878, and subsequent communications on the same subject, I have the honour to state that the Committee appointed by the Government of Bengal in January last to examine and report upon the means of providing technical instruction have not yet submitted their report. The general principles, which have been so far accepted by the Committee, may, however, be learnt from paragraphs 202, 203 of my General Report on Public Instruction for 1877-78. But it should be remembered that any industrial schools which may be established in pursuance of the recommendations of the Committee are intended generally for the natives of Bengal, and not specially for children of railway employés.

2. For the benefit of the latter class the Government has recently purchased the "Constantia" estate at Kurseong, and plans are under preparation for the erection of a school-house on the site. This school, which is to give general and not technical instruction, is intended primarily for the benefit of the children of the employés on State Railways, who will be educated and boarded at reduced rates Other children will also be admitted, both to the boarding and to the day-school, up to the limit of the accommodation that may be provided, and these children will pay fees at full rates.

Extract paragraphs 202 *and* 203 *from the Annual Report on Education for* 1877-78.

PARA 202. In January 1878 the Government of Bengal appointed a Committee to examine and report upon the means of providing thorough technical instruction to those who wish to adopt one of the branches of engineering as a profession. The necessity for connecting the schools to be thus established with workshops in actual operation was insisted on, and Calcutta was named, in addition to Dehree, as the best site for a large workshop (the need for which was independently felt), and for a school in connection with it. The Committee met twice before the close of the year. It was estimated that the work to be done would abundantly justify the erection of shops on the largest scale In considering what manner of schools should be established in connection with the shops, the Committee kept in view the following points:—

Firstly, that two separate courses of instruction were necessary in order to train candidates for employment in the Public Works Department or on district roads—the upper course designed for those who desired to become Engineers of roads and bridges, and the lower course for those who wished to qualify for subordinate appointments of the same kind These are the objects for which the Civil Engineering College is maintained. That college would therefore come under the consideration of the Committee; and it was noticed that theoretical and practical work were unduly dissociated under the present regulations, by which a student has only one year's training in a workshop after the completion of his college course.

Secondly, that two other separate courses were required for the training of men designed for mechanical pursuits—the upper course for those who desired to become Mechanical Engineers of the highest class and Directors of large manufacturing establishments, and the lower course for the training of Overseers of shops and factories, foremen of works, &c. For neither of these two purposes is special proficiency in a single trade needed: it will be sufficient if a man has such practical skill as may be gained by four years' work with his own hands alternately in the pattern-shop, the forge, the foundry, and the fitting-shop.

The difference between the upper course and the lower course in either branch, whether of civil or of mechanical engineering, will be that, while theoretical and practical training are combined in both, the upper course will carry theoretical instruction to a much higher standard.

203 *Special Instruction*.—The object of the Committee has therefore been to provide instruction, on the one hand, for District Engineers and for Overseers of roads through the Civil Engineering College; on the other hand, for Mechanical Engineers and Overseers of works through the technical school to be established in connection with the new workshops. Students of these four classes should be required to know English to the Entrance standard, and should be taught through English. But the proposals do not involve the training of mechanics, that is, of men skilled in particular trades. It is thoroughly understood that in order to produce workmen of this class, nothing can supersede the ordinary mode of apprenticeship. No school is needed for this purpose: the only school in which men can learn their trade is the workshop. But that condition being understood, schools for workmen, whether apprentices or skilled mechanics, can with advantage be set up. The object in the one case would be to provide apprentices with the rudiments of education (if they do not already possess it) in the belief that the more intelligent the man, the better the workman. And in the case of skilled mechanics, the object is to select the most skilful and intelligent among them, and to give them further instruction, by means of night classes, like that already set up by Colonel Hyde, in mechanical drawing with the use of scales, and possibly in the elementary principles of mechanics. "Foremen," says Colonel Hyde, "are the best and most skilled of journeymen, who have acquired sufficient education to enable them to take the lead and maintain the position of foremen. A good foreman can, as a rule, outwork any man under him."

No. 3951, dated Calcutta, the 18th November 1878.

Memo. from—The Secretary to the Government of Bengal, General Department,
To—The Secretary to the Government of Bengal, Public Works Department.

In forwarding the marginally noted papers to the Public Works Department of this Government regarding the establishment of industrial schools in Bengal for children of railway employés, I am directed to say that the General (Education Department has no detailed information as to the working of the industrial school at Dehree, or as to the scheme for providing technical instruction, which the Committee referred to by Mr. Croft is now considering. I am therefore to suggest that the reply to be given to the letter from the Government of India should be considered in the Public Works Department in communication with the Joint-Secretaries to the Railway and Irrigation Branches.

Copy of letter No. 2030R, dated 24th May 1878, from the Government of India, Public Works Department.
Letter from the Director of Public Instruction, No. 6752T, dated 31st October 1878.
Extract paragraphs 202 and 203 from the General Report on Public Instruction for 1877-78.

2. I am to add that provision for the technical training of the children of the State Railway employés might very possibly be made in connection either with the Dehree or Calcutta training schools and workshops. This department would be glad to be furnished with any detailed reports upon the Dehree School, or with a copy of any communication that may be addressed to the Government of India.

No. 974E., dated Calcutta, the 31st May 1879.

Memo. from—The Secretary to the Govt. of Bengal, Public Works Department,
To—The Secretary to the Government of Bengal, General Department.

With reference to paragraph 2 of General Department memorandum No. 3951 of the 18th November 1878, the undersigned has the honour to forward four copies of a note by Colonel F. T. Haig, R.E., late Chief Engineer, Bengal, Irrigation Branch, on the Dehree Training School, which contains a brief account thereof from its establishment and its subsequent progress.

Note by COLONEL F. T. HAIG, R.E., *Chief Engineer, Bengal, Irrigation Branch, on the Dehree Training School for Foremen Mechanics with special reference to the proposed enlargement.*

I MAKE the following extract from a note by the Superintending Engineer, Sone Circle, dated the 18th May 1874 :—

"In briefly describing the origin of the Dehree Training School for Foremen Mechanics, I cannot begin better than by quoting from a memorandum, dated 6th December 1870, by Colonel F. H. Rundall, R.E, then Chief Engineer, Bengal, Irrigation Branch. He says—"The subject alluded to in the accompanying correspondence originated in a circular by the Government of India regarding the best mode of recruiting the upper subordinate establishment of the Public Works Department. In the resolution contained in that circular the Governor-General in Council considered that at the present time it would be necessary to look elsewhere than to India for artificers skilled in ironwork, machinery, brick-making, &c., and an application was made to the Secretary of State to engage some 30 men of the various classes required. At the same time other suggestions were made as to how the supply of the remainder might be obtained in this country.

The Secretary of State, in complying with the requisition, trusted that it was not intended to be frequently repeated, and suggested that the Government might, "by keeping a constant look out" for men whose engagements on the railways had terminated, recruit their own establishment by taking such men into their employ. The Government of India, in circulating the despatch of the Secretary of State, impressed on the Local Government "the great advantage of endeavouring, as far as possible, to train the natives of this country in all those branches of handicraft that are necessary to the construction and maintenance of railways," and added "that well directed and persistent efforts should be made so to qualify natives as to justify their employment in the position of foremen."

"On the 8th March 1871 the Government of India in its No. 334E.G. sanctioned the formation of a training school at Dehree "by the admission of 20 apprentices, half of whom should be Europeans and half natives," and at the same time called for detailed proposals, which were sanctioned in Government of India's No. 139E.G. of the 30th January 1872 in the following terms :—

1st.—To appoint a European school-master on a salary of Rs. 200 per mensem.

2nd.—To give the Foremen in charge of the works a fee of Rs. 5 per mensem for instructing each lad.

3rd.—To give Christian lads subsistence allowance at Rs. 20 each per mensem, one-fourth of which to be ordinarily paid by the parents or other relatives.

4th.—To give the native lads Rs. 5* per month, one-fifth to be paid by the relatives.

* Rs. 8 per month was afterwards sanctioned—*vide* Government of India's No. 787E.I. of 30th May 1873.

5th.—The payment in both cases to continue only until the lads are able to support themselves by their earnings in the workshops.

6th.—The boys to be bound by indenture to serve from four to six years.

7th.—The lads who, at the end of this period, possess the required qualifications, to be drafted into the department as upper subordinates; if not qualified for this position, to be sent to executive divisions, and their pay charged to works, or to be admitted as lower subordinates until fit for the upper subordinate establishment.

8th.—To build separate quarters for the Christian and native lads, and for the school-master, at a cost of Rs. 6,746.

"As soon as accommodation was provided, advertisements were inserted in the newspapers informing the public that a training school for foremen mechanics had been started at Dehree; replies came in rapidly, and I may here mention that in six months no less than 733 applications had been received: this alone is, I think, sufficient to show the popularity of the school, and the great need of such institutions.

"Selection was then made of 20 Europeans and Eurasians, and 20 native lads, from whom 10 of each were to be chosen for ultimate admission to the school after a trial of three months; the total number sanctioned being only 20 as before mentioned.

"From what has been above stated, it will be seen that the principal object of Government in establishing the school was to train up *native* lads; but it was very soon found that this was most distasteful to them; they were willing enough to attend school, but they generally refused to work with their own hands; numbers came, but went away when told they must use the hammer and chisel. In short, at the time the school was started, only two native lads had consented to remain.

"On the 20th of August 1872 the school was opened with 19 European and Eurasian boys and two natives, under the teaching of a European school-master, the whole under the immediate direction of Mr. Fouracres, the Executive Engineer of the Workshop Division, who from the very first had taken the warmest interest in the matter. Two hours per day were set aside for school instruction—the subjects taught being arithmetic, algebra, euclid, practical geometry, plan-drawing, estimating, and subsequently writing English from dictation. Six hours were devoted to the workshops, the boys being distributed some in the fitter's shop, others in the foundry, blacksmiths' and carpenters' shops, &c., all were obliged to work with their own hands, the object being to make them thoroughly understand the use of the various tools and machines.

"The report of the examination held on the 13th February 1873 showed that the progress made in the school in the first six months was very satisfactory, while the boys had so far progressed in the shops that the earnings of each were estimated at from Rs. 3 to Rs. 8 per month, and the whole earnings to Rs. 130 monthly.

"At this time (February 1873) the number of native lads had increased to five only; application was therefore made for permission to retain the whole of the European and Eurasian boys who had turned out very well, and were anxious to remain, and the Government of India in its No. 787E.I. of the 30th May sanctioned this arrangement."

2. Thus by the time that the preliminary process of natural selection had taken place, and the proportions of the two races had been determined by their own inclination and adaptation to the kind of special training proposed, the number of boys with which the school may be said to have opened was 20 Europeans and 5 Natives.

3. None of these boys had been subjected to any qualifying examination before entrance. This proved a most serious disadvantage, as while some had a fair knowledge of arithmetic or algebra, others were not expert even at compound substraction. Classification therefore became extremely difficult, and much of the master's time and efforts were wasted, while the results attained at the end of the course were not satisfactory.

4. The next batch of boys was admitted in 1875. In this case the selection was made by competitive examination, the subjects being arithmetic as far as interest, some algebra, and part of the first book of euclid. The competition was open to all boys between the ages of 14 and 16 Altogether 46 went up for examination, all of them Europeans or Eurasians. Not a single native competed. Twenty obtained the qualifying number of marks, of whom 12 were selected. They joined the school in Nov. 1875, along with one native, a Bengali, admitted without examination by the Executive Engineer at Dehree.

5. Another batch ought, accordingly to the original intention, to have been admitted the following year, but the constantly decreasing expenditure on Public Works, and the consequent necessity for reduction of establishments, raised doubts as to whether employment could be found for as many lads from the school as was at first supposed, and this, together with some unfortunate circumstances which shook confidence in the management of the school, and lead to a long enquiry and revision of the system, resulted in the postponement of the examination for another year. It has recently been held, under the same conditions as before, with the addition of dictation to the subjects. The limits as to age were also raised from 15 to 17, instead of 14 to 16 as on the previous occasion.

6. Previous notice had been given by advertisements in the public papers, but failed apparently to attract much attention from school-masters and school committees, as no application for admission to the examination had been received from such institutions as the Free School, Calcutta, St Paul's School, Darjeeling, the Lawrence Asylum, &c., until shortly before the day fixed for it. Reminders were sent to the Principals, and also to Cuttack and Nynee Tal.

7. The examination was held simultaneously at Calcutta, Allahabad, and Sunawar (the last for the Lawrence Asylum only). The number of boys who presented themselves for examination was—at Calcutta, 36; at Allahabad, 11; at Lawrence Asylum, 3; total, 50.

8. Examination papers would also have been sent to the other places mentioned if required, and intimation was sent to that effect, but none were asked for.

9. In all 50 boys were examined, of whom seven only were natives, six of them Bengalis and one a Telinga.

10. The result is shown in the following statement:—

School.	Number examined.	Number who obtained $\frac{2}{3}$th of total marks	Number selected.
Free School, Calcutta	7	2	2
Lawrence Asylum, Sunawar	3	2	2
Other Lawrence Asylums	0	0	0
St. Paul's, Darjeeling			
Diocesan School, Nynee Tal			
Cuttack ditto			
Doveton College 4	40	24	18
St. Xavier's ditto 1			
La Martiniere ... 3			
Calcutta High School 4			
Bengal Academy 1			
St. James' School 2			
St. Joseph's ditto 1			
St. Thomas' ditto, Howrah 2			
Serampore College 1			
Bhowanipore Institution 2			
La Martiniere, Lucknow 2			
Bishop Cotton's School, Simla 1			
St. Peter's College, Agra 1			
Christ Church School. Cawnpore ... 1			
Dehra and Landour School 1			
L. M. S. Institution, Benares 2			
Dacca College 1			
Late of the Lawrence Asylum ... 1			
Mymensingh School 1			
Chupra ditto 2			
Burrisal ditto 1			
Assensole ditto 1			
Educated at Jerusalem 1			
Not specified 3			
Total ...	50	28	22
Of whom, natives	7	2	2

11. The total number of vacancies in the school was 24, of which 22 have been filled up as shown above. The other two have been offered by the Lieutenant-Governor for competition by the sons of members of the Behar Eurasian Association. Three boys were selected by the Commissioner to compete, but the result is not yet known. Two of these, if they qualify, two of the Lawrence Asylum boys, and one from the Calcutta Free School, will receive free nomination; the rest will be admitted on the usual condition, viz., a contribution by their parents towards the cost of subsistence of Rs. 5 monthly in the case of Europeans and Eurasians, and Re. 1 in that of natives.

12. The original intention of the Government, when the school was opened, was, as already explained, that half the boys should be natives. This result, it will be observed, has not been attained. Very few natives have even competed for entrance, and though an attempt has repeatedly been made by Mr. Fouracres to get such boys into the school by dispensing with the examinational test, it has always been without success. From whatever cause, the advantages offered by the school do not appear to attract native lads who have received an English education, though there are plenty of boys, sons of native artizans and others, who have had either no education at all, or only such as they could pick up through the medium of their one vernacular, who are only too glad to avail themselves of the practical instruction given in the shops.

13. The number of boys and cost of the school, in each year from its commencement, are shown below:—

Year.	Europeans and Eurasians.	Natives.	Total.	Cost.	Remarks
				Rs.	
1872-73	14	5	19	3,321	Eight months only.
1873-74	20	4	24	4,231	
1874-75	20	5	25	8,205	
1875-76	31	8	39	13,190	
1876-77	21	7	28	14,198	
1st January 1878 ...	11	5	16	.....	

14. The first batch of boys who went up for the final examination at the termination of their four years' course in 1876 were six in number. The test applied was the same as that required for Overseers entering the Public Works Department, and the papers were set by the Principal, Calcutta Civil Engineering College. Only one boy passed, obtaining 680 out of a total of 1,300 marks. None of the other scored more than 306.

15. This result was considered at the time discouraging and even discreditable, but it was sufficiently accounted for by the circumstance already mentioned, viz, that the boys who first entered the school had been subjected to no previous test, and turned out to be of such very different attainments as greatly impeded the work of further instruction, and also by the fact that it was not until the year before the final examination took place that the master was told what subjects it would include and the degree of acquaintance with each which it would require. The lad who passed was appointed to the department in the grade of Overseer. The others, together with six more who left the school at different times and did not go up for examination, are all doing well. One is in the department as Sub-Overseer with the prospect of rising to the higher grade whenever he may qualify; two are in the employ of the Calcutta Municipality; another is a Draftsman; two more are employed by engineering firms in Calcutta; another is Engineer in a tea plantation in Assam; and four are Engineers on board steamers. All, I believe, are in receipt of fair salaries, and all have received such an education as will enable them, if steady and industrious, to earn a respectable livelihood.

16. The next batch of boys, eight in number, presented themselves for the Overseer's examination in August 1877. Seven passed.

17. The result must be allowed to be very creditable to both pupils and teachers. None of those who passed, however, have as yet received appointments to the department, and a good deal of disappointment is felt in consequence.

18. The Government of India decided some months ago that the course of training in future should be such as to fit the boys to be foremen mechanics, rather than to qualify them for the ordinary work of the Public Works Department. This requires a few changes in the course of study, and also in the subjects to be taken up in the final examination. Rules upon the latter point have yet to be made.

19. The boys, however, who are now in the school, have requested that whatever standard may be fixed for the examination which all will be required to pass, they may be allowed also to go up for the Overseer's examination for entrance to the Public Works Department. To this there can, of course, be no objection.

20. With regard to the practical training in the different kinds of handicraft, the boys spend five hours daily in the workshop, and pass, as a rule, through the carpenters, fitters, and blacksmiths' shops, and foundry. Half-yearly reports of their progress are submitted by the foreman in charge of the different shops; and as a further test the work they turn out is valued at the rates current in the shops; and the result shown in the reports submitted to Government. Appendices A and B are specimens of these. Further details as to the management of the school will be found in Appendix C, which contains a memorandum for the information of applicants for admission, the standing orders, and the time-table of work and studies.

21. The school is intended to turn out 12 young-men annually so thoroughly trained as to be eventually fitted to be foremen mechanics. Appointments to the Public Works Department are not guaranteed to those who pass, but it is promised that efforts will be made to provide for as many as possible. The full number that ought to be in school in order to yield this outturn would be, for a four years' course, with some allowance for contingencies, 56. There are at present in the school 15 only. Twenty-two have just been appointed, and two more will follow from Behar. With these additions the total will be raised to 39. Seventeen more have yet to be appointed in two annual instalments.

22. The following is the most recent estimate of the cost of the school for a total of 56 boys:—Establishment, Rs. 9,048, *Boarding expense*, Rs. 5,516, and Miscellaneous, Rs. 2,279.

The total, Rs. 16,943 is nearly identical with that of the sanctioned annual outlay.

23. With a four years' course, and an annual outturn of 12 lads, the total cost of each to Government would thus be Rs. 1,400.

24. The Lieutenant-Governor now proposes to enlarge the school in three ways—

(1)—By throwing it open to all boys who may be willing to pay the full amount, Rs. 20 per month, of the cost of subsistence, instead of Rs. 5 only as allowed to the present students.

(2)—By granting scholarships from the Behar Industrial School Fund tenable by Beharis at Dehree, such scholarships being of an amount sufficient to pay a boy's expenses for subsistence and clothes, say Rs. 8 per month.

(3)—By assigning a sum of Rs. 8,000 to Rs. 10,000 per annum for the provision of similar scholarship from the educational grant; the scholarships to be distributed among the different schools and colleges of Bengal.

25. With regard to the first, I see no difficulty or objection to the immediate admission of a good many boys on such terms. It would involve little or no additional expense. Mr. Gilmore, the Master, thinks he could teach up to 100 boys single-handed. He has now (or will have when the new batch joins) 39 only. The full number at present contemplated is 56.

26. The present school buildings, and the bungalows now vacant, which were occupied by various members of the establishment when the weir was being built, will accommodate about 90 boys, after setting apart one for a school-house, an addition to the present accommodation, the want of which is much felt. One or two more servants might be necessary. Rupees 20 is found to be quite sufficient to cover all expenses for food, servants, washing, and lighting, but not clothes. The boys when they enter the school bring with them a mattrass, knife and fork, plates, and mug. All instruments, tools, books, cots and furniture are provided by Government. The education in school and training in shops are also at the expense of Government, which has besides to bear the cost of material wasted by the boys.

27. The charge, therefore, for boys paying all their expenses might be fixed at Rs. 20 per month, and no doubt numbers of parents will be glad to get their sons into the school on these terms. Some have already asked to be allowed to do so.

28. It will be necessary, I think, that boys admitted on these terms should pass the same Entrance examination as that now required from the regular students, otherwise it would be impossible for the same master to carry on the education of all together. Probably any man willing to pay Rs. 20 per month will have already given his boy such an education as would enable him to pass his test.

29. With regard to the proposed Behar scholarships, the only difficulty appears to be that so very few boys are likely to be found possessing the necessary qualifications, *i. e.*, able to pass such an Entrance examination as that which is required from the present students. Mr. Croft tells me that any boy educated up to the University Entrance examination could easily pass this one. Now, as a fact, not a single Behari has yet even attempted to compete for admission to the school. Either, then, there are few or none of the Beharis who are educated up this point, or for some reason or other the school does not present sufficient attractions to them. The latter is certainly not the case for some classes of Beharis, for there are numbers of boys in the vernacular school at Dehree who are employed in the shops, and who would gladly avail themselves of the advantages of the upper school if they were within their reach. I do not see precisely how this difficulty about a supply of candidates from Behar can best be met; but it occurs to me that advantage might perhaps be taken of the vernacular school for the purpose, and on talking the matter over with Mr. Gilmore, who is now in Calcutta, I find that the idea is not a new one.

30. There is, then, a vernacular school at Dehree as well as the English one. It was originally commenced with a view of giving a certain amount of education to the native boys in the shops, mostly the sons of blacksmiths, carpenters, &c., employed there. There are two masters on Rs. 25 and Rs. 15 a month paid from the educational grant; and there are at present about 50 boys, half of them working in the shops, and half outsiders

31. None of the boys receive any allowance from Government, but the education is free. Those working in the shops are mostly employed by petty contractors, and by degrees rise to a position in which they are independent and can earn their own livelihood. There are men now in the shops who learnt their trade in this way. The education is wholly vernacular, and includes, besides reading, writing, and arithmetic, a smattering of algebra, euclid, and mechanics. The Head Master is described as an exceedingly zealous, painstaking man, who has accomplished much with the boys with little or no help in the way of instruments, books, &c.

32 If an English class were added to this school, under a master capable of educating the boys up to the standard of the Entrance examination for the upper school, might not this be the best means of furnishing the most suitable native students for the latter? A boy entering the lower school at 10, ought by the time he is 15 to have attained the necessary proficiency, and would also have acquired a fair knowledge of his native language, and become tolerably expert in one or more of the trades taught in the shops. The lower school would thus become a preparatory school for the upper, and the Behar Fund scholarships might be given for the support of boys in the English class. They might be competed for, and the competition be thrown open to all Behar schools, the examination being in the vernacular only, and the test about the same as that which the older boys in the Dehree lower school could now pass, *i.e.*, reading, writing, and arithmetic, with a little algebra and euclid. Some at least of the scholarships provided by the fund might perhaps be advantageously applied in this way.

33. The Lieutenant-Governor also proposes to distribute a number of scholarships for the training school among all the schools and colleges of Bengal. There seems to be no difficulty about this. There would probably be active competition for them, though most might be carried off by Europeans and Eurasians. The competitors in the recent examination came from at least 24 different schools and colleges in all parts of Bengal, as will be seen from the list in paragraph 10.

34 Supposing the above proposals carried out and scholarships given as suggested, there would still remain a class out of reach of any of them—a class not perhaps numerically important, but one whose prospects are peculiarly hopeless as matters now are. I mean the lower class of Eurasians and Europeans—boys who (1) either could not compete in the vernacular, or whose parents cannot afford to educate them up to the Entrance standard; or (2) who have already, either in free schools, or by dint of great sacrifices on the part of their parents, been educated up to that standard, but cannot afford to pay even the Rs. 5 per month now required.

35. Of the latter class, the Lieutenant-Governor intended that some should have been provided for in the appointments which have just been made to the school, and directed that 6 out of the 24 vacancies should be reserved for boys who should receive their education free. Actually only three have thus been filled up—two from the Lawrence Asylum and one from the Calcutta Free School. A difficulty was found in ascertaining which cases were really deserving, and there was not time to make the necessary inquiries.

36. It seems as if it would be necessary to have a special examination for this class of candidates, and to require satisfactory proof beforehand that the parents or guardians are really unable to pay the fees.

37. The needs of the first-mentioned class might perhaps be met by setting apart scholarships to be competed for by the same examination in English as that proposed in the vernacular for entrance to the English class of the lower school. This would be a very great boon, and would be a most important step towards raising a most hopeless class to a position of independence The question is what the amount of such scholarships ought to be.

38. I believe Rs. 12 would be ample for food, servants, &c., in the case of East Indians and Europeans, and Rs. 5 for natives. Neither class spend half that amount in their own houses for the same purpose, but living at a distance from home expenses would be greater, and boys engaged for some hours daily in manual labour must be well fed.

39. It might be sufficient at starting to limit the number of scholarships to—

Twenty at Rs. 5 tenable by natives of Behar in the lower school.
Ten at Rs. 12 tenable by Europeans and Eurasians in the lower school.
Ten at Rs. 8 tenable by natives from any part of Bengal in the higher school.
Ten at Rs. 20 tenable by Europeans and Eurasians in the higher school.

40. If 10 more boys paid all their expenses, then the full number in school would be 60 + the present number 15 + those just appointed 24=99. This number, as already stated, I think, could be accommodated in the present buildings. The addition to the educational staff required would be an English master for lower school

41. The different bungalows and other buildings which would be appropriated to the use of the boys would require some extra fittings, and the survey buildings, which would be used for a school-room, must be re-roofed; but probably a few thousand rupees would do all that is required.

F. T. Hiag, *Col.*, R.E.,
Chief Engineer, Bengal, Irrigation Branch.

The 10th January 1878.

APPENDIX A.

Yearly Report of the Dehree Training School.

2ND YEAR'S CLASS.

NAMES OF BOYS.	Marks obtained in examination; full marks 800.	Result.	EARNING DURING THE YEAR. Amount.	Number of working months.	Proficiency in shops.	Number of entries in defaulter's book.	REMARKS
			Rs. A. P.				
Pemberton	634	Good	70 0 0*	12	Very good	None	The entries of less than 12 months against the names of certain apprentices indicate that during the remaining period they were ill, on sick leave, or no records were kept of their work.
Young	567	,,	26 7 0	11	,,	,,	
Mathews	547	,,	29 8 0	10	,,	,,	
Hohenboken	523	,,	22 8 0	10	Very fair	,,	
Hollis	501	,,	32 8 0	11	Very good	One	
Rebello	485	,,	32 8 0	8	Good	None	
Shome	416	Fair	11 0 0	8	,,	One	
Rose	405	,,	31 8 0	8	Very good	None	
Stevens	384	,,	35 8 0	8	Good	,,	
Gungopadhia	365	Indifferent	9 8 0	8	Indifferent	One	
Turnbull ...	354	,,	21 0 0	11	Good	None	
Ahmed	272	,,	10 8 0	11	Indifferent	Two	
Hill	534	,,	28 8 0	12	Good	None	
Choonee Lall Ghose	278	,,	47 8 0	9	Very good	,,	
Caw		Sick	18 4 0	9	Pretty fair	,,	
Bhugwan Dass		,,	11 8 0	9	Fair	,,	
A Meyer		,,	7 0 0	7	Very good	,,	
H. Collins ...		,,	10 8 0	9	Fair	,,	

* Was sent to Eastern Sone Division, hence cause of large amount.
† Had to supervise foundry in absence of foreman.

C. KAMIL CUNY,
Offg. Exe. Engr., Dehree Workshop Divn.

APPENDIX B.

Statement showing the amount that each apprentice could actually earn monthly if working 8 hours per day for 24 days per month.

NAMES.	Number of working days at 8 hours per day from 1st January 1877 to 1st September 1877.	Corresponding number of working months at 24 days per month.	Total earning from 1st January 1877 to 1st September 1877.	Amount which could have been earned in a full working month (24 days).
			Rs. A. P.	Rs. A. P.
Pemberton	89	3 17/24	59 14 6	16 2 0*
Young	60 1/2	2 12/24	22 1 8	8 11 0
Mathews	64 1/2	2 16/24	20 12 1	7 13 0
Hohenboken	75 1/2	3 1/24	15 0 9	4 12 0
Hollis	68 1/2	2 21/24	27 0 0	10 3 0
Rebello	58	2 10/24	28 5 5	11 9 0
Shome	50 1/2	2 1/24	7 8 0	3 5 0
Rose	56 1/2	2 8/24	21 10 5	9 6 0
Stevens	63 1/2	2 23/24	27 10 7	10 8 0
Gungapadhia	50 1/2	2 1/24	5 11 2	3 0 0
Turnbull	75 1/2	3 5/24	15 2 0	4 12 0
Ahmed	63 1/2	2 19/24	6 3 7	2 4 0
Hill	48 1/2	2 1/24	20 11 1	10 5 0
C. L. Ghose	72 1/2	3 1/24	40 11 4	13 9 0†
Caw	72 1/2	3 1/24	14 5 10	4 10 0
Collins	26 1/2	1 2/24	5 4 10	4 8 0
Bhugwan Dass	29 1/2	1 5/24	7 2 6	5 11 0
Cartland	39 1/2	1 15/24	11 9 5	7 4 0
Radford	47	1 23/24	16 13 7	8 11 0
Farren	45 1/2	1 22/24	9 7 5	5 8 0
Williamson	46 1/2	1 23/24	12 3 2	6 3 0
J N Ghose	38 1/2	1 14/24	10 11 3	6 14 0
Hardy	49 1/2	2 1/24	27 2 10	13 5 0‡
A. Gantzer...	42 1/2	1 18/24	8 13 7	5 2 0
Wilson	13 1/2		6 8 3	11 11 0
P. C. Mitter	31 1/2	1 7/24	7 13 3	1 0
Meyer	17 1/2		4 3 0	5 7 0

* Amount of earning calculated at Rs. 25 per month, being on out-door works.
† Earned Rs. 20 in one month, having supervision of works in moulding shop.
‡ Had supervision of works in carpenter shop a few days.

N.B.—The total number of days, as per column 2, have been arrived at by dividing the total number of hours worked during the period from 1st January 1877 to 1st September 1877 by 8.

C. KAMIL CUNY,
Offg. Exe. Engr., Dehree Workshop Divn.

APPENDIX C.

Memorandum for the information of Applicants for admission into the Dehree Training School.

A GOVERNMENT training school for foremen mechanics is now open at Dehree-on-Sone in connection with the Dehree Workshops.

2. Two classes of apprentices are entertained. Apprentices of the second class are native lads, who receive practical instruction only, and are not further considered in this memorandum.

3. First class apprentices may be either European (and Eurasian) or native. The former are obliged to reside in the school under the superintendence of the school-master. Rupees 26 per month is allowed for their subsistence; of this sum one-fourth, or Rs. 5, is payable (in advance) by their parents or guardians, the remaining three-fourths is paid by Government. Native apprentices receive Rs. 8 per month as subsistence allowance; of this sum Re. 1 only is payable (in advance) by their parents or guardians, the remainder being paid by Government.

4. That part of the subsistence allowance payable by parents or guardians must be sent to the Executive Engineer, Dehree Workshop Division, Dehree-on-Sone, Shahabad. Money-orders payable at Arrah will be received, or if more convenient the money may be paid in Calcutta to the Executive Engineer, Northern Drainage and Embankment Division, whose receipt must be sent at once to the Executive Engineer, Dehree Workshop Division. An apprentice whose subsistence allowance is two months in arrears will be removed without further notice. Parents and guardians will be warned when the subsistence allowance is one month overdue. No subsistence allowance will be payable by parents and guardians on account of any boy whose earnings are sufficient to cover the whole cost of his maintenance, and such sum as is under the standing orders of the school payable to the apprentice himself.

5. Boys must on the 1st day of October of the year of their admission be above 15 and under 17 years of age; they must be able to write English well from dictation, have a sound knowledge of elementary arithmetic, including proportion, and vulgar and decimal fractions. Subject to these qualifications, a preference will be given to boys who are acquainted with the first 26 propositions of the first book of euclid, and have some knowledge of algebra. If there are more candidates than vacancies, the most qualified will be selected; but only boys who are ound in bodily health and of robust constitution will be admitted.

6. Candidates for admission must produce a certificate of birth, or other clear proof of age, and satisfactory evidence as to their character. All candidates must produce medical certificate of sound health and physical fitness for manual labour.

7. The boys will be bound by an agreement to serve an apprenticeship of four years, and will be solely under the control of the Executive Engineer of the Dehree Workshop Division for the time being

8. The boys will spend the greater part of their time in the workshops, but will receive in the school instruction in mathematics and other subjects likely to prove useful to them in the exercise of their trade.

9. The Executive Engineer, Dehree Workshop Division, has the power, subject to the previous sanction of Superintending Engineer, to remove an apprentice who is guilty of—

A.—Habitual or gross misconduct.

B—Continued idleness or indifference in the workshop or school.

10. No boy will be kept in the school who from any cause appears unlikely to prove qualified as a foreman mechanic. On this point the decision of the Superintending Engineer will be final.

11. Apprentices who pass through the school are not granted appointments, but an endeavour will be made to provide for those whose character and attainments seem likely to fit them for employment in the Public Works Department.

12. Apprentices who do not receive appointments will have received, without charge, a good education and efficient instruction in mechanical engineering: whilst receiving this, instruction they will have been for the most part supported by Government. If industrious, they cannot fail to secure a respectable livelihood.

13. Ordinarily 12 boys will be admitted about November, each year, who will be appointed by Government on the recommendation of the Chief Engineer.

14. Notice of vacancies will be given by public advertisement.

15 With the view of providing for orphans, and for cases in which candidates are in indigent circumstances, free nominations will be given to a few selected candidates. In these cases the Rs 5 ordinarily levied from parents—*vide* paragraph 3—will be paid by Government. But not more than four free admissions will be given in any one year, and candidates who receive them will only be admitted if their place in the Entrance examination would, independently of the free nomination, justify their admission.

16. Suitable clothing must be provided by parents or guardians.

17. Any further information may be obtained from the Executive Engineer, Dehree Workshop Division, Dehree-on-Sone, Shahabad, to whom all correspondence should be addressed.

Memorandum of the conditions under which Master is received into the Dehree Training School.

He will be received subject to the provisions set forth in the "Memorandum for the information of applicants for admission to the Dehree Training School."

2. He will pay his own travelling expenses to Dehree-on-Sone.

3. He will be received for four years, but he will be considered on probation for six months, at the expiration of which, if it appears he is not physically fit for the work, or if for any other reason it appears inexpedient to retain him, he will be sent back to his friends at the expense of Government.

4. The Executive Engineer, Dehree Workshop Division, has the power, subject to the previous sanction of the Superintending Engineer, Sone Circle, to remove a boy who is guilty of—

I.—Habitual or gross misconduct.

II.—Continued idleness or indifference in the school or shops.

5. The undersigned
will for four years, commencing from the of 18 , provide Master
with suitable clothes and pay in advance on the 1st of each month, to the Executive Engineer, Dehree Workshop Division, Dehree-on-Sone, the sum of Rs. per month. In consideration of these provisos, Master
will be fed, provided with free quarters and books, and receive proper instruction as a foreman mechanic

Signature of parent or guardian ———————————

Address ———————————

Witness ———————————

Address ———————————

Signature of Joint-Secretary to the Government of Bengal, in the Public Works Department, Irrigation Branch. ———————————

Witness ———————————

Address ———————————

Dated of 18

Standing orders to be observed in the Training School attached to the Dehree Workshop Division.

The Executive Engineer, Dehree Workshop Division, is *ex-officio* the Principal of the School. The school-master is primarily responsible and in every respect subordinate to him. In the absence of the Executive Engineer his powers will be exercised by any Assistant Engineer to whom he may delegate them; but all orders issued by an Assistant Engineer are subject to the Executive Engineer's confirmation: in the meantime the orders are to be carried out

2. The apprentices are entirely under the control of the Executive Engineer, who is empowered, with the previous sanction of the Superintending Engineer, Sone Circle, to remove a boy who is guilty of (*a*) habitual or gross misconduct, (*b*) continued idleness or indifference in the workshop or school. Minor punishments may be inflicted by the Executive Engineer and by the school-master to the extent authorized in these orders.

3. The school-master will make arrangements for the boys' food, and will see that it is served to them in time to attend the workshops and school punctually.

4 No apprentice is on any account to be allowed to keep a private servant.

5. The apprentices will attend the workshops and school according to a time-table approved by the Superintending Engineer. The Executive Engineer will make proper arrangements for recording their attendance.

6. Leave of absence from the school or shop will only be allowed on written orders signed by the Executive Engineer. The school-master will apply for this leave for sick apprentices, and will make suitable arrangements for their comfort whilst in hospital, under such orders as he may receive from the Surgeon. The Executive Engineer will fix limit beyond which no apprentice is allowed to proceed without written permission. Leave on medical certificate to be guided by the Code rules.

7 A defaulter's book (Form No. 80, P. W. Code) will be kept for every boy; every entry in this sheet will be signed by the Executive Engineer and the apprentice, and a copy transmitted monthly to the Superintending Engineer. The Executive Engineer has no power to cancel or erase an entry once made.

8. Apprentices are liable to have their names placed in the defaulters' book for—

I.—Disobedience of orders.
II.—Absence without leave.
III.—Absence from quarters after 8 P.M.
IV.—Continued idleness in school.
V.— Ditto ditto in workshops.
VI.—Insubordination or impertinence to the Executive Engineer or their instructors.
VII —Frequent entries in the conduct register for petty offences.

The Executive Engineer may direct the names of apprentices guilty of offences coming under the foregoing heads, but not of a serious nature, to be entered in the conduct register instead of the defaulter's book.

9. The book called the conduct register, in the same form as the defaulter's book, is to be kept up. Petty offences and the punishments awarded will be recorded in this book. The school-master will keep this book, which will be submitted to the Executive Engineer for signature every Saturday. The Executive Engineer may cancel or modify any entry made by the school-master before signing it

10. The school-master is empowered to punish a boy for infractions of school discipline, by entering his name in the conduct register as reprimanded, and by confining him to school, and employing him on any suitable work for one hour of the Saturday half-holiday. The Executive Engineer can for any offence inflict the foregoing punishments, and is also authorized to (1) degrade a boy from his position as Monitor of Discipline, or Bungalow or Workshop Monitor; (2) confiscate the whole or any part of his earnings during the month.

11. A Monitor of Discipline, and Bungalow and Workshop Monitors will be appointed by the Executive Engineer: the former will receive Rs. 4, and the latter Rs. 3 and Rs. 2 respectively per month. They may be removed for the cause mentioned in section 9, or if the Executive Engineer considers them unfit for any cause to preserve order or to conduct any of the duties assigned to them.

12 Every apprentice will be allowed one-fourth of his earnings, which will be deposited in the District Savings Bank to his credit, but no apprentice can be credited with anything in any month on which his name is entered in the defaulters' book. The amount thus credited will be paid to apprentices on their leaving the school, provided they complete their course or leave for a cause not affecting their character

13. No apprentice will receive, on any account, remuneration or allowance, except as provided in paragraphs 11 and 12

14. Half-yearly examinations by Examiners nominated by the Superintending Engineer will be held in February and August. The result of these examinations, with particulars regarding the conduct and earnings of the boys, will be submitted by the Executive Engineer, Dehree Workshop Division, in the annexed form, for transmission to Government. A short narrative report giving some account of the progress of the school during the year will be submitted after the Christmas vacation for the information of Government.

15. A leaving report in the annexed form, with a copy of apprentice's defaulter's book during the whole of his apprenticeship, will be submitted to the Superintending Engineer when a boy leaves the school. Those leaving reports and defaulter's book will be transmitted to Government for record, in case an apprentice at any subsequent time applies for Government employment.

DEHREE TRAINING SCHOOL.

TIME TABLE.

First Year.

No instruction on Saturdays after 12.

6 to 7	Arithmetic ...	3 days
	Algebra ...	3 „

A. M.

7 to 8	Euclid, books I and II	3 „
	Mensuration	3 „
10 „ 12	Workshops.	

P. M.

2 „ 3	Orthographic projection, the construction of scales, and the use of mathematical instruments ...	4 „
	Chemistry	1 day.
3 „ 6	Workshops.	
7½ „ 8½	Physical Geography	2 days.
	Experimental Physics	2 „
	Lecture one day (Wednesday).	

Second Year.

A. M.

6 to 7	Arithmetic	3 days.
	Algebra	3 „
7 „ 8	Euclid, books I to IV	3 „
	Trigonometry	3 „
10 „ 12	Workshops.	

P. M.

2 „ 3	Orthographic projection as applied to engineering drawings	4 days.
	Chemistry	1 day.
3 „ 6	Workshops.	
7½ „ 8½	Mensuration	2 days.
	Experimental physics	2 „
	Lecture	1 day.

A. M. *Third Year.*

6 „ 7	Algebra	3 days.
	Trigonometry	3 „
7 „ 8	Mechanics	3 „
	Exprimental Physics	3 „
10 „ 12	Workshops.	

P. M.

2 „ 3	Drawing	4 „
	Chemistry	1 day.
3 „ 6	Workshops.	
7½ „ 8½	Mensuration	2 days.
	Euclid	1 day.
	Arithmetic	1 „
	Lecture	1 „

A. M. *Fourth Year.*

6 to 7	Algebra	2 days.
	Euclid, books I to IV	2 „
	Trigonometry	2 „
7 „ 8	Mechanics	3 „
	Experimental Physics	3
10 „ 12	Workshops.	

A. M.

2 „ 3	Drawing	4 „
	Chemistry	1 day.
3 „ 6	Workshops.	
7½ „ 8½	Arithmetic	2 days.
	Mensuration	2 „
	Lecture	1 day.

N. B.—The morning study to be from 6 to 8 or 7 to 9 at the discretion of Executive Engineer.

Summary showing hours per week taken for each subject.

No.	Subject.	Hours per week.				Total.	Remarks.
		First year.	Second year.	Third year.	Fourth year.		
1	Arithmetic	3	3	1	2	9	
2	Algebra	3	3	3	2	11	To quadratic equations.
3	Euclid	3	3	1	2	9	Books I to IV only.
4	Mensuration	3	2	2	2	9	
5	Drawing	4	4	4	4	16	
6	Plane Trigonometry	...	3	3	2	8	Simple properties on angles only.
7	Mechanics	...	...	3	3	6	
8	Experimental Physics ...	2	2	3	3	10	
9	Chemistry	1	1	1	1	4	
10	Physical Geography	2	...	...	...	2	
11	Workshops	27	27	27	27	108	
12	Lecture	1	1	1	1	4	
	Total ...	49	49	49	49	196	

No. 483E.G, dated Fort William, the 14th March 1879.

Memo. by—J. G. THORPE, Esq., Offg. Under-Secy. to the Government of India, Public Works Department.

THE following is forwarded to the Secretary to the Government of Bengal, Public Works Department, for report.

No. 5, dated London, the 6th February 1879.

From—Her Majesty's Secretary of State for India,
To—His Excellency the Right Hon'ble the Governor-General of India in Council.

YOUR Excellency's letter of the 11th November last has acquainted me with the steps taken by your Government to further the establishment of schools in India for the training of natives for the position of foremen mechanics in the Public Works Department, and I have learnt with satisfaction of the successful operation of the schools established—the one at Dehree in Bengal, and the other at Roorkee in the North-Western Provinces.

2. I see that your letter alludes more especially to the promise of success up to 1873 in regard to European and Eurasian lads. I do not gather how far the success has since extended also to the training of native lads; but this is manifestly a matter of the highest consequence, and I shall be glad to have some recent information on the subject.

3. I am addressing separate communications to the Governments of Bombay and Madras with a view to ascertaining if schools of a like nature have been instituted in those presidencies.

Bengal, P. W. Department, order dated the 23rd April 1879.

FORWARDED to the Irrigation Branch, with a request that the information required by the Right Hon'ble the Secretary of State in the second paragraph of his despatch as regards the Dehree School may be forwarded to this branch.

No. 117T., dated Darjeeling, the 21st July 1879.

Memo. by—H. C. LEVINGE, Esq., Joint-Secy. to the Govt. of Bengal, P. W. Dept., Irrigation Branch.

COPY of correspondence marginally noted forwarded to the Secretary to the Government of Bengal, in the Public Works Department, for information, with reference to No. 483E.G., from the Secretary to the Government of India, Public Works, Department, to his address, herewith returned.

From Superintending Engineer, Sone Circle, No. 2539 of the 8th July 1879.
From Executive Engineer, Workshop Division, No. 1275, dated 6th May 1879, to the Superintending Engineer, with enclosures.

2. The training school at Dehree for foremen mechanics, as will be seen from the accompanying report, has never been popular with the natives of the better classes, who generally dislike working with their own hands. It was then proposed, in order that the native element might not be unrepresented, to train up in the vernacular school at Dehree the sons of the men working in the workshops, and thus to fit them for entering the upper or training school for foremen mechanics; but the contemplated amalgamation of the Dehree School with that at Calcutta, and the reduced scale on which it is proposed in future to maintain the shops at Dehree, render it undesirable to carry these proposals into effect, or to establish the English class in the vernacular school as recommended by the Executive Engineer.

3. The Lieutenant-Governor has, however, decided that the vernacular school at Dehree is to be kept up, as the shops at that place, though reduced as regards outturn of work to be done, will still afford much instruction, and he is, moreover, of opinion that a vernacular class should be established in connection with the new school in Calcutta. A slight knowledge of mechanics, arithmetic, &c, is undoubtedly an immense advantage to a workman.

No. 2539, dated Arrah, the 8th July 1879.

Memo. from—J. P H. WALKER, Esq., Superintending Engineer, Sone Circle,
To—The Chief Engineer, Bengal, Irrigation Branch.

UNDERSIGNED has the honour to forward herewith report of the Executive Engineer, Workshop Division, in which he supplies the information required by the Secretary of State for India, as notified in Assistant Secretary's No 1666*I.E.* of the 25th April last.

The Executive Engineer has been requested to submit definite proposals for the English school he proposes should be established in connection with the vernacular school lately sanctioned by the Lieutenant-Governor. There really seems every probability that the failure (for it is practically a failure) to attract educated natives to the training school will eventuate in results of a very encouraging kind.

No. 1275, dated Dehree, the 6th May 1879.

From—C. FOURACRES, Esq., Executive Engineer, Dehree Workshop Division,
To—The Superintending Engineer, Sone Circle.

WITH reference to your No. 1585, Chief Engineer's No. 1666*I E.*, and Secretary of State's letter, dated India Office, 6th February 1879, I have the honour to report that since the formation of the Dehree Training School 24 native apprentices have been appointed to it by the Government and Superintending Engineer, as per list attached. It will be seen that

out of 24, 9 have absconded, 3 were sent away that could not be recommended by the Executive Engineer for indenture, 1 was dismissed being unfit, 1 resigned, 1 was dismissed for disobedience, 1 died, and 5 served out their terms of apprenticeship and obtained appointments in the Public Works Department, leaving 3 now in the school.

Besides the above number, several native youths have come to school to see what it was like, and the Executive Engineer wishing to encourage them gave them work, but they all left after a few days, evidently thinking the work too hard for them or below their position.

The school has up to date never been able to keep up the number of native apprentices sanctioned by Government. The Executive Engineer, as far back as May 1874, with the sanction of the Superintending Engineer, Mr. Levinge, started a vernacular school for the sons of the native workmen, and on the Lieutenant-Governor's visit here His Honour ordered a school-house to be built for these native boys, and sanctioned the appointment of two native masters for the school from the Educational Department.

These boys attended the school two hours daily. The rest of their time is spent in the shops. The whole of the work done in the foundry is now done by these boys, as well as a great deal of work in the fitter's shop, and nearly all the lathes and machines are managed by them.

It was proposed by Mr. Levinge that from these boys we should recruit the native apprentices for the training school for foremen mechanics, seeing the difficulty we had in getting a sufficient number of educated natives for the training school, and I think the time has arrived when we could select many boys who are, except for their ignorance of English, fit for transfer. In this case it would be necessary to have an English master appointed to teach them English.

These boys are very sharp fellows, already possess a good amount of skill at their trade, and if taught now will not be above their work or think themselves degraded (like the boys educated up to a certain standard before they enter a workshop do as a rule), being all sons of workmen, and always in contact with workmen and their work. They will certainly, in my opinion, turn out good men and make first-rate foremen if educated for it.

I have at present in the workshops undergoing instruction and attending the vernacular school 40 boys (these boys earn, and are paid from Rs. 1-10 to Rs. 4-1 per month), besides 20 boys, the sons of natives of this locality. The vernacular school is open to all-comers, and any boy can get two hours daily instruction free. Sir Andrew Clarke examined these boys when in Dehree last month, and expressed great satisfaction with their abil ty, as also did the Director of Public Instruction, who examined them some months ago I beg to send copies of official reports entered in the visitor's book for information.

I would most respectfully point out that these boys are getting a good sound training at their respective trades, besides being educated in the vernacular, far beyond the standard acquired by boys who learn a trade in England, and that I have every reason to recommend that an English class be formed to teach them English, so that they may be able to join the English classes in the training school, and thus carry out the full intention of Government to train natives for the position of foremen mechanics.

Report by Bhooder Mookerjee, *Inspector of Schools.*

4th January 1878.—The Dehree School (for native boys) has 60 names on the rolls: out of these 60 lads 25 attend the workshops. I examined these boys with some care, and was greatly satisfied to find that they have been well taught in most of the subjects of their study. One of them demonstrated very intelligently a proposition of euclid, and another attempted to answer some easy problems in the principles of the lever and the inclined plane. The boys attend the school lessons but two hours per day, passing the rest of their time in the workshop, and yet the progress made by them is decidedly superior to that which I have seen exhibited in most of the middle schools of these parts, where boys are made to attend their books for nearly six hours per day. The success attained by the teachers of this school is not very creditable to themselves, but may be taken as a proves that if children are made to handle tools, their senses are better trained, and as a consequence their intellectual powers more thoroughly awakened than if their attention is confined to the pages of a book or books. The school (for European and Eurasian children) could not be seen, as the students were away on leave.

Report by the Officiating Deputy Inspector of Schools, Shahabad.

23rd February 1878.—Visited the school this day, and found 62 boys reading, of whom 27 attend the workshop. I examined the first class boys, and was glad to find that they could answer the questions of arithmetic and geometry satisfactorily, though they failed to explain something in their Nagri reading book. It will be a matter of great credit to the school, and of use to the boys, if some of them (who do not attend the workshop) are prepared and sent up for the next vernacular scholarship examination. I see all the books of the examination, except history and geography, are taught here. If the teachers try for it (having been permitted), they will be successful in their attempt without much care and trouble.

Remarks by Mr. J. W. Edgar, *Collector, Shahabad.*

23rd August 1878.—I was present to-day at the examination of the two first classes in the Dehree School for native boys, and was very much pleased with the result. All the boys in the first class showed a really creditable knowledge of the first book of euclid, which they evidently understand. They have also made some progress in the second book. They were not so good in algebra and arithmetic, but they were far indeed from failing in these subjects, and they showed a most satisfactory knowledge of mensuration and rudimentary

mechanics. They are reading the *Ramayana* of Tusi Das with manifest intelligence. The boys of the second class also answered very creditably in the subjects in which they were examined. Altogether, I have seldom seen a more satisfactory school of its class and kind. The master deserves great credit, and I hope he may get some promotion soon His pay is very small, considering what he is doing.

Report by the Officiating Sub-Inspector of Schools.

26th December 1878.—I visited the Dehree Vernacular School (for natives) and found 67 boys present out of 74 on the rolls, of whom there are only 36 boys, both Hindus and Mussulmans, who daily attend the workshop after the school is dismissed (in this season at 9). The school remains open daily in the mornings for two hours, from 7 o'clock to 9 o'clock, for all the boys, and again in the evening from 3 to 5 o'clock, only for the boys who do not attend the workshop. I examined the boys of all the classes in every subject taught in this school, and was very much glad to find them well up in mathematics, of which particular care is taken in this school. It seems that the students have received a good instruction of the subjects, and really understand the purport of it.

History and geography are not taught in this school.

The teachers are very intelligent, painstaking, competent, and fit for the post in they have been employed. I shall have much pleasure to see them in a higher post than they hold at present.

Remarks by Mr. A. W. Croft, *Director of Public Instruction.*

3rd May 1879.—An admirable school, adapted to train mechanics, theoretically and practically, on the best continental model. I examined the boys of the first class in the mechanical powers (pulley and lever), the rectangle of forces, and the principles of geometry not confined to euclid. I found them ready-witted, as well as familiar with their subjects; able to adopt old principles to problems in a way which somewhat surprised me

The head master, M. Debi Doyal, and his assistant are thoroughly competent men, and take considerable pride in their work.

I should recommend the introduction of Vidya-Ke-Neo and Vidyankur into the school (instead of Premsagar), so as to give the boys some acquaintance with elementary physical facts.

List of Native Apprentices enlisted in the Dehree Training School from 1872 *to April* 1879.

No	Names	Caste.	Date of joining.	Date of leaving	Remarks.
1	Juggessur Surma ..	Brahmin ..	August 1872 ..	July 1873	Absconded.
2	Bissessur Laul	Kyast ..	Ditto ..	September 1876	Went after completing the term of his apprenticeship Failed in the final examination to pass as an Overseer.
3	Rashbehary Mookerjee	Brahmin	Ditto ...	April 1874 ...	Died of small-pox.
4	Poorno Chunder Mitter	Christian .	October 1872	October 1877 ..	Same as No. 2
5	Brojo Laul Gangooly	Brahmin	December 1872	February 1878	Absconded.
6	Jogendra Nath Ghose	Kyast ...	August 1873 ..	12th September 1877.	Went after completing the term of apprenticeship Was successful in the final examination.
7	Gumput Sahai	Ditto	November 1873	December 1874	Absconded
8	Seetul Pershad	Ditto .	Ditto	Ditto ..	Ditto
9	Kedar Sing	..	December 1873	April 1874 ...	Ditto.
10	Prag Sing .	Rajpoot ...	Ditto .	March 1874 ...	Could not be recommended by Executive Engineer for indentures
11	Ramessur Mookerjee ..	Brahmin .	Ditto	Ditto ..	
12	Dhunonjoy		January 1874 ..	March 1874 .	
13	Issan Chunder Shome . .	Kyast ...	June 1874 ..	June 1878 ...	Same as No. 2
			Ditto ...	March 1875 ...	Absconded
			Ditto	October 1874 .	Ditto
16	Woopendra Nath Roy ..	Rajpoot .	July 1874 ..	Ditto	Ditto.
17	Nogendra Nath Roy ..	Ditto ..	Ditto ...	Ditto ...	Ditto.
18	Shama Churn Gangooly .	Brahmin ..	September 1874	July 1878 ...	Same as No. 2.
19	J Stephenson .	Christian	May 1875 ...	October 1875 . .	Was dismissed, being unfit.
20	Meer Johoor Ahmed	Mahomedan	August 1875 ...		Resigned
21	Bhugwan Dass ..	Smith .	July 1875 ..	June 1877 ...	Dismissed for disobedience of orders and absence without leave
22	Chooneelaul Ghose .	Sutgope .	January 1876 ...	.....	At present in school
23	S. N. Gupta .	Vydah ..	January 1878 .	.....	
24	B. S. Naidoo .. .	.....	Ditto ..	.....	

No. 133T., dated Darjeeling, the 28th July 1879.

From—H. C. Levinge, Esq., Secy. to the Govt. of Bengal, Public Works Dept.,
To—The Secretary to the Government of India, Public Works Department.

Referring to your No. 483E.G. of the 14th March 1879, forwarding for report copy of a despatch from the Secretary of State, enquiring what success had attended the attempt to train native lads for the position of foremen mechanics, I am directed to enclose copy of a memorandum from the Chief Engineer, Irrigation Branch, Bengal, with enclosures, which shows that the Dehree Training School has not been popular with native lads of the better classes, but that for the last five years there has been a most successful vernacular school for the sons of native workmen, who, as described by Mr. Fouracres, manage nearly all the lathes and machines, do all the foundry work, and much of the work in the fitter's shop.

I am desired to state that the Dehree School will shortly be amalgamated with a practical training institution about to be established at Calcutta, and that the Lieutenant-Governor has no doubt that the training of native lads for the position of foremen mechanics will then be successfully carried out.

CHAPTER IV.

NOTE BY A. W. CROFT, Esq., DIRECTOR OF PUBLIC INSTRUCTION

The Education of Mechanics and Engineers.

In a note, dated 24th February 1868, Mr. Leonard, Officiating Chief Engineer for Bengal, explained his views on the need of an institution for the practical training of subordinates for the Public Works Department, which he represented as urgent. He was in favour of establishing a school, to be called the Public Works Subordinate School, the qualifying test for admission to which should be such a tolerable knowledge of English and mathematics as could be gained in any zillah school. In this school the pupils should learn simple surveying, plan drawing and estimating, and easy practical mechanics; but in none of these branches should they learn anything more than would make them useful as Overseers, leaving all scientific work to be done by Assistant Engineers. After passing one year in school, the pupils should be drafted to selected works in progress, in each of which a thoroughly good subordinate officer should have nothing to do but take charge of the pupils and teach them actual work. From among these pupils, according to the certificates which they might gain, Overseers should be selected for the Public Works Department. The grade of Sub-Overseers, theoretically trained, should be abolished altogether, and in their place should be substituted artizans selected from the workmen.

2. As to the education of artizans, Mr. Leonard insisted that nothing would make a good artizan but working with his own hands for years under, or beside, a good master. Fully admitting that it was very desirable to bring useful education within the reach of every member of the community, Mr. Leonard denied that any special advantage was to be gained from educating artizans: he even ventured to say that a man "would not work a whit better if he knew how to survey, draw and calculate, than if he were in total ignorance of these acquirements." He urged that the best practical way of making a good workman was to have Overseers in all grades who knew what good work was and how to get it done. This object had been thoroughly carried out at the Akra brick-fields, and it was possible to get equally good Overseers in all branches of work. He advocated the establishment in Calcutta of a yard for the manufacture of all kinds of ordinary ironwork and of easily transportable woodwork. This, he believed, might be kept up without much, if any, loss; and would be as useful for educational purposes in the practical training of Overseers as Akra was in its own branch of work.

3. In a note written in May 1869, Colonel Nicolls drew attention to some defects in the system of training Assistant Engineers in the Presidency College. An institution of that kind ought to exercise a larger influence than the college was found to do. It ought not only to provide Government with officers for its public works, but should do something towards aiding the private engineering enterprizes of the country Yet it was not known that any students of the college had found employment with private firms or in railway workshops. Mercantile concerns in fact wanted only effective hands; and if they took a person who did not know his work, they required a premium for teaching him. They looked to practical efficiency rather than to theoretical knowledge, though not undervaluing the latter if combined with the former Colonel Nicolls proceeded to show how the training of Assistant Engineers might be improved. According to the present system, a student is admitted to the L. C. E. examination after three years' collegiate training. The only practical training which he gets during that period is in surveying, and that is admittedly good and sufficient. The rest of his practical training is provided for by sending him, after taking his degree, for one year to the Government workshops, and for a second year to works in progress. The so-called training in works in progress is necessarily given by officers who have not sufficient time to spare from their ordinary duties for giving such regular instruction as the pupils require. Colonel Nicolls fully endorsed Mr. Leonard's views as to the deficiencies in the practical training both of Engineers and of subordinates, and as to the injury caused thereby to Government work. He therefore proposed to create a Professorship of Practical Engineering. The holder of this appointment should be an Executive Engineer in charge of a model division, to consist of "one or more large works, such as the large Presidency buildings, some large bridge, or other similar important work. He should be assisted by a subordinate staff as might be necessary, and should teach practical construction, including management of work and of work-people, proper keeping of accounts, checking quantities, &c; and he should be responsible for the attendance and behaviour of his pupils He should take the pupils from the Presidency College, in whatever grade they may have passed out, and employ and train them accordingly. He should also take practical workmen and train them, giving them the eventual advantage of his certificate; and a certificate from him, that a man was a thoroughly practical man, and could keep the usual accounts and measure up ordinary work, should be sufficient qualification for employment in the lower grades of the department. The present scholarships (of Rs 50 a month) might remain for the upper grades; practical workmen should be paid the value of their work, and the Overseer and Sub-Overseer class should receive subsistence allowance for such numbers as it may be thought desirable to keep in training for the department" Colonel Nicolls therefore desired to provide for the practical training of Assistant Engineers in much the same way as was proposed by Mr. Leonard for subordinates, and the two proposals will fit in together. But it is to be noticed that Colonel Nicolls did not then contemplate any such radical changes in the school-training of Overseers and Sub-Overseers as Mr. Leonard's proposals involve. He described the training given to Overseers in the Presidency College as "excellent," and accordingly accepted the existing system by which a student, passing out of college at the end of one or of two years, becomes entitled to a certificate qualifying for the grade of Sub-Overseer or of Overseer, respectively.

4. The Government of India had meanwhile expressed cordial approval* of Mr. Leonard's views, and asked that specific proposals for carrying them out might be submitted. In complying with this request, Colonel Nicolls went into further detail. He pointed out that the branches of work in which practical instruction was most needed were the following—

No 722E., dated 5th May 1869, to Secretary to Government of Bengal, Public Works Department.

Brick-making.	Carpentry and joinery.
Brick-laying.	Ironwork.
Building.	Machinery.

Brick-making was already provided for at Akra. Brick-laying and building required no special provision of this kind; the ordinary works that might happen to be in progress would furnish sufficient opportunities for practical training. For instruction in carpentry and joinery it was necessary to establish a properly organized yard in Calcutta; not necessarily, or chiefly, on grounds of economy, but with the object of maintaining and teaching a good standard of work. An iron yard was even more urgently required, not only for training purposes, but on general departmental grounds, in consequence of the increasing use of irons work in all parts of the country and for all purposes. "Some of our Engineers from England have certainly served their time in ironwork, and are most useful, but they cannot be employed everywhere, nor yet always be made available" Colonel Nicolls therefore proposed to establish in Calcutta a yard, "wherein our recruits would thoroughly learn making trusses and girders, setting up ironwork, making good petty deficiencies in ironwork sent out from England, &c., leaving their knowledge of the larger operations connected with ironwork to be obtained, as may be practicable, from the mint, Cossipore foundry, &c." Practical knowledge of machinery might be gained, partly in the yard and partly in the mint, the Cossipore foundry, and other similar establishments. Instruction should concurrently be given in measuring up work, in checking quantities of labour and material, in keeping a control over expenditure, and in the general account operations which each class of students is required to know.

5. In this note Colonel Nicolls adopted Mr Leonard's views as to the uselessness of the class of Sub-Overseers, and recommended the substitution of sirdars or foremen, real workmen chosen for practical ability in their trades, or for organizing and controlling power. He added that the school, though established mainly for departmental purposes, should be open, under fixed conditions, to all who desired to receive practical training in the various branches of work carried on.

6 The following estimate was framed of the cost of establishment, scholarships, and first outlay—

			Total per mensem
Principal's salary	Rs	900	
Assistant Principal's salary	„	600	
Four foremen of branches	„	1,200	
Five Engineer scholarships at Rs. 50	„	250	
Ten Overseer scholarships at Rs 30	„	300	
Ten Overseer scholarships at Rs. 25	„	250	
			3,500
Cost of yard and compound walls	„	7,500	
Principal's residence	„	25,000	
Workshed and shops	„	25,000	
Plant and tools for carpenters	„	12,500	
Ditto for blacksmiths	„	25,000	
			95,000

7. The Government of India in their reply* doubted the utility of a workshop, intended as this was entirely or mainly for students. A shop for engineering purposes to serve as a school must be conducted in a thoroughly efficient and economical manner. Either, then, some existing establishment of suitable character must be made use of for the purpose of giving practical training, or, if no such establishment existed, a new one must be organized "on the basis of thoroughly efficient general mechanical shops, capable of turning out all the miscellaneous work needed for the Public Works Department in Calcutta and its vicinity. Shops for the purpose in view should have a variety of real, not fictitious, work to do;" and the Government of India accordingly requested that definite proposals for the establishment of such a shop might be made.

No 52E.G, dated 10th January 1870, to Secretary to Government of Bengal, Public Works Department.

8 The question was referred by the Government of Bengal to a Committee, consisting of Messrs. Boyce, Isaac and Bruce, who reported on the 2nd June 1870. The Committee came to the conclusion that if shops were established for general wood and ironwork, and all departmental orders were executed therein, work to the amount of 3 or 3½ lakhs a year might be expected. This would involve a capital outlay, amounting to Rs. 5,30,000, made up as follows—

Block	Rs	2,05,000
Machinery...	„	1,25,000
Stock	„	2,00,000
		5,30,000

The interest on this outlay, the cost of establishment and of manufacture, and the depreciation of block and machinery would together exceed the receipts from manufactures; and the Committee estimated that the result would be a net loss varying from Rs. 6,000 to Rs. 20,000 a year, according as the higher or the lower estimate of work to be done was accepted. But the Committee added that their estimates were framed according to existing departmental requirements, and that if the future demands of the State Railways were taken into consideration, the increased outturn of work on this account would probably make the establishment of shops a profitable investment.

9. The Government of Bengal accepted the Committee's conclusion that the establishment of a general mechanical shop could not, on financial grounds, be recommended. At the same time, that Government pointed out that its intentions and wishes had been misunderstood by the Government of India. Colonel Nicolls' note had explained that, in order to secure efficient establishments, a certain amount of practical training was essential. In some branches of work this practical training was already supplied, and it remained to provide special means of instruction in the simpler operations of carpentry, joinery, and ironwork For this purpose general mechanical workshops were not required. Such shops were no doubt necessary for the training of skilled mechanics; but the question in hand was the training, not of mechanics, but of Overseers, and it was only necessary to construct the shops on such a simple scale as would give departmental officers, after their theoretical training, such practical insight into work of various kinds as would speedily fit them for the active duties of their profession. There seemed to be no greater reason why the practical training of the candidates, any more than their theoretical teaching, should be a paying arrangement. In view however, of the great difference of opinion which existed on this important subject, the Lieutenant-Governor in conclusion declined to propose any definite scheme. The question accordingly dropped.

10. In 1871 the question was raised in another form. In reference to a requisition made by the Government of India for 30 European artificers, to recruit the upper subordinate establishment of the Public Works Department, the Secretary of State expressed the hope that measures would be taken to train in India both natives and Europeans for the position of 'foremen mechanics.' For this purpose the large railway and irrigation works about to be undertaken would form an unexceptionable training school. The Government of India observed that "every large work of the magnitude of a railway or canal, and every shop in connection with such, forms a training school for artizans; and from these there is no doubt that some suited for the position of foremen could be obtained. To ensure this result it will probably be necessary to attach a school to each large shop, which likely men should be encouraged to attend, and those that give promise of rising to the responsible position of foremen should be helped, and their practical knowledge supplemented with theoretical training and some instruction in drawing." This was intended to apply, not only to natives, but also to Europeans already in the country: either class, if trained as mechanics, and educated in such branches of knowledge as would make them better workmen, would supply the place of foremen mechanics from England.

11. The practical outcome of these orders was the establishment, in August 1872, of the Dehree Training School, into which it was proposed to admit annually 20 apprentices, half natives and half Europeans. It was also resolved to appoint a European school-master on Rs. 200 a month; to give the foremen in charge of the shops a fee of Rs. 5 a month for the instruction of each apprentice; and to sanction a maintenance allowance of Rs 20 a month for each European pupil, out of which Rs. 5 were to be paid by his parent or guardian, and of Rs. 8 a month for each native pupil, out of which he was to pay Re. 1. It is to be observed, however, that from the very outset the principle on which the Dehree School was established seems to have departed in some measure from the object which the Secretary of State and the Government of India had in view. That object was to train up in India a body of mechanics skilled in special trades; in other words, of "artificers specially experienced in ironwork, machinery, brick-making, &c.," and generally, "in all those branches of handicraft that are necessary to the construction and maintenance of railways." From among the men who were thus being trained, the most promising were to be selected, and educated in such a way as to fit them to become foremen in their special trades But in the Dehree School, as constituted from the first, the acquisition of special single trades was subordinated to the need that exists in India of Overseers competent to supervise many branches of work together. Colonel Haig, in a note written in October 1871, dwelt on the great need of "properly trained foremen mechanics capable of taking charge of a small workshop, repairing engines and other machinery, putting together iron bridges and boats, &c." Accordingly, the apprentices of Dehree are not trained, one to be a blacksmith, another to be a fitter, and then educated, in drawing and the like, so as to qualify them for the post of a foreman of fitters or a foreman of blacksmiths—which is what I understand by the term "foreman mechanic"—but all alike are passed in succession through the carpenter's shop, the foundry, the smithy and the fitting-shop; and at the same time they receive a somewhat advanced theoretical education in mathematics, surveying and science. Mr Fouracres stated, in October 1874, that "as the apprentices are shifted from one branch to another, it cannot be expected that they would earn in the new shops as much as in the old. Our object here is to give them a general training, to make them suitable to conduct works of various kinds, and to look for the returns at the termination of their apprenticeship, namely, good practical men." The apprentices are therefore trained, not to become "foremen mechanics," but to occupy the position of Overseers in the mechanical branch of the Public Works Department; just as Colonel Nicolls' proposals were intended to train men more

effectively as Overseers in the General Branch, by giving them, in addition to their college course in civil engineering, some practical instruction in wood and ironwork and in the use of simple mechanics. The character of the Dehree course can be inferred from the present occupation of some of those who have been trained in the school. Of the first batch of pupils, one is in the Public Works Department in the Overseer grade; another is a Sub-Overseer; two are in the employ of the Calcutta Municipality; another is a Draughtsman; two men are employed by engineering firms in Calcutta; another is Engineer in a tea-garden in Assam; and four are Engineers on board steamers All are in receipt of fair salaries, but none are exactly foremen mechanics.

12. It may be a question whether, in any training school to be established, separate provision should be made for training foremen mechanics and Overseers of works respectively. This may possibly be unnecessary, not only in regard to the special conditions of work in India, but also because a man trained generally as an Overseer will usually display aptitude for one branch of work over another; and his special aptitude being encouraged and developed, he will become an efficient foreman in his own branch. Still, in principle, the training of a foreman and the training of an Overseer are very different: the latter requires a higher standard of theoretical education, and therefore appeals to a different section of the classes from which pupils or apprentices are to be drawn. It should be added that the examination for Overseers, which the Dehree apprentices have to pass, requires that, in six out of the twelve compulsory subjects, the candidates must attain the standard of knowledge required for Assistant Engineer. The time devoted to these studies would, if spent in the shops, of course make them better workmen as far as regards merely mechanical skill.

13. In 1874 the course of instruction in the Dehree Training School was as follows:— Six hours a day were devoted to the workshops, and two hours to school. The subjects taught in school were arithmetic (the whole), algebra to quadratic equations, euclid (the whole), practical geometry, mensuration of surfaces and solids, trigonometry and logarithms, principles of estimating, plan drawing, the mechanical powers, and problems on work. By this time it was found that, while the school was very successful in training Europeans and Eurasians, native lads, though willing enough to attend school, refused to work with their own hands; "numbers came, but went away when told they must use the hammer and chisel." In short, at the time the school was started, only two out of ten native lads selected had consented to remain, though their number was afterwards increased to five.

14. At the first establishment of the school in 1872, when no educational test was imposed, 733 candidates applied for admission. At the next admission of pupils in 1875, a preliminary examination was held in arithmetic, algebra, and part of the first book of euclid: only 46 candidates went up for examination, and not one was a native, though a Bengali youth was afterwards admitted. At the examination of 1877 50 candidates applied, of whom seven were natives. This reluctance on the part of native boys to compete applies only to those who have received an English education; for there are numbers of boys of lower caste, sons of native artizans and others, who are only too glad to avail themselves of the practical instruction given in the shops. It is for the benefit of these last that the lower or vernacular school has been opened at Dehree. The boys learn to read or write their own vernacular, and also receive a very good grounding in arithmetic, geometry, and the elements of mechanics

15. In 1875 all the workshops required by the Public Works Department were concentrated into one yard at Hastings, and advantage was taken of this to organize an industrial school for the practical instruction of the passed students of the Civil Engineering Department of the Presidency College Other native students were also allowed to enter the institution in order to receive practical instruction in carpentry and ironwork under skilled workmen. At the same time Colonel Nicolls, Colonel Hyde, and Mr. Sutcliffe were requested to consider and report on the general question of technical instruction for natives.

16. The report was drafted by Colonel Nicolls. He proposed to establish a Public Works school, having two distinct objects:—

1*st*—The primary object of making expert mechanics of the native pupils entering the school.

2*nd*—The further object of completing the professional education of the passed students of the Civil Engineering College, by affording them practical instruction in the various kinds of work connected with engineering.

For the training of mechanics it would be necessary to establish workshops, to teach the following trades:—

(*a*)—Carpentry and joinery.

(*b*)—Ironwork, including ordinary blacksmith work, foundry work, erecting girders, &c.

(*c*)—Painting, including plumbing and glazing.

Each trade should have a separate yard to itself, and be under a European foreman, with as many pupils as he could conveniently teach. Every pupil should be restricted to a single trade; each should have passed a simple educational test before admission; but all should learn mechanical drawing while in the school.

It would also be necessary to supply instruction to pupils in—

(*d*)—Brick-making.

(*e*)—Brick-laying, including plastering.

The former was already provided for at Akra, and the latter could only be taught by means of public works in progress. The foremen in these, as in the other branches, should receive a fee for each pupil efficiently instructed, and the whole institution should be under a Public Works officer of the grade of Executive Engineer.

17. Provision was also to be made for an 'artizan class' of pupils working with the ordinary tools of the country. There would always be much technical work in this country where machinery could not be applied, and where it would be of the greatest importance to have good ordinary workmen. It would be a pity, Colonel Nicolls thought, if the institution turned out men who were useless without European tools and machinery; and it would fail in usefulness unless it made the training of ordinary workmen with their own tools one of its chief objects. Such pupils should be admitted without any educational test. But such among them as showed special aptitude and intelligence might be drafted into the mechanical class on passing a simple educational test, and be admitted to the full benefits of the school. For both the mechanical and the artizan class scholarships were to be established. Pupils in the mechanical class, between the ages of 12 and 15 or 16, were to be bound as apprentices; older pupils would be free to go as they liked.

18. Colonel Nicolls' proposals for the practical instruction of the passed pupils of the Civil Engineering College were much the same as those which he had previously made. Pupils of this class relied more on intelligence than on practical skill; they worked with their heads rather than their hands; and it was accordingly necessary to give them a general acquaintance with all trades rather than proficiency in one alone Their studies should be directed by a superintendent with one or more assistants, whose duty it should be to explain the processes of manufacture, to teach the measurement of work, the keeping of accounts, and the management of work-people, and generally to impart to them that practical knowledge which an engineer required. It should also be his duty to take his pupils to the Cossipore foundry, the Mint, and other places where large mechanical operations were carried on, in order to explain and teach those processes which the workshops of the institution did not attempt. The tables appended to the draft report gave detailed statements of the establishment, plant, &c., that would be required.

19. Colonel Hyde and Mr. Sutcliffe (in a joint note written by the former) objected to the report in principle and in detail; objected to calling the workshop a school, to calling the workmen and boys in it pupils, and to giving scholarships and fees. Men who were being trained to be workmen should be called workmen and not pupils; if they were really pupils, that is, if the workshop was not a shop but a school, the whole thing would be an expensive failure, since it was impossible to teach trades in a school. Colonel Hyde insisted on the fact that a trade could only be "acquired by practice and actual work in a long service of several years. Men cannot be taught, nor could they acquire skill, from doing work simply for approval; they must do real work, that is, they must work on what is wanted, and they must see the result of their labours put to good use: this observed result will alone bring home to them the proper realization of their labours." And again:— "I consider it absolutely necessary that the shops should be devoted to work that will pay; nothing is so demoralising to a worker as to be employed at work on which there is not any result; while, on the other hand, a good useful result on work is a great stimulus to good men, and if the outturn from the shops realized good prices, or goes into good and known structures, this end is attained; so that I think better progress will be gained by making instruction subservient to the work done, for this will in fact give the best instruction." Colonel Nicolls, on the other hand, appears so to have framed his scheme as to make the work done subservient to instruction.

20. Colonel Hyde objected to scholarships on the ground that every one must be paid for his labour on equitable terms. He urged also that the trades were not sufficiently subdivided, and proposed the following—

A.—Carpenters, joiners, pattern-makers	...	In the wood yard.
B.—Smiths	..	In the metal yard.
C.—Founders and moulders, iron ...	...	
D.— Ditto ditto, brass	...	
E.—Fitters and turners ...	...	
F.—Painters, plumbers, and glaziers	...	Subsidiary to both yards.

He objected further to the proposal to afford any recognition to native tools Our great object should be to try to supersede them by creating a standard of better work. His experience showed him that, as soon as a man has taken in hand and improved work insisted on, his first request was for English tools. It followed that the workshops should use machines largely, and make every endeavour to get work done concurrently with English tools.

21. As to foremen, Colonel Hyde pointed out that "in England, and indeed in every practical country, foremen are the best and most skilled of journeymen, who have acquired sufficient education to enable them to take the lead and maintain the position of foremen. A good foreman can, as a rule, outwork any man under him. In this country it has been the custom in many works not to select a foreman after this practical fashion, but to take him from those who in some way or other fail to obtain the position of engineers." Such a man "is at the mercy of the workmen under him, and is the most useless idler one can imagine. If journeymen are carefully watched in the shops and made to attend the drawing class, good foremen will come to the front and assert themselves, driving to the wall the useless makeshifts now employed."

22. For the training of engineer students, Colonel Hyde maintained that no useful instruction could be given by taking the pupils of the Civil Engineering College to visit the Mint, the Cossipore foundry, and other similar places. Whatever was done in those factories must be done independently by the heads of the institutions. He urged the workshops and a class of practical architecture as the only remedy. By practical architecture he meant the drawing and studying of buildings from actual works, with lectures on those works, as distinguished from book-work and drawing from copies.

23. Major Eckford, who was also consulted, objected to the proposed school on the ground that it would strike out an entirely new system of training mechanics which would be sure to end in failure and waste of money Apprenticeship alongside of a good journeyman was the only way of learning a trade. Major Eckford believed that if a certain number of sharp lads of the artizan class were bound apprentices in actual shops, and if after five years the pick of these were taken and taught a little drawing arithmetic and geometry, to write English figures, and to write their own language in the Roman character, much would be done towards getting useful journeymen or leading hands, as smiths, turners, fitters, moulders, pattern-makers or carpenters. He added:—'The nuisance with our present men is that they cannot calculate, and they cannot communicate by writing with those who employ them." As to the practical training of pupils in the Civil Engineering College, he believed that the proposed workshop would not suffice for this purpose. A knowledge of processes and appliances was essential to an engineer, and if he could use his own hands, too, so much the better. In the workshop, again, he might practise himself in the use of tools and make up models of machines; but this would not supersede the need of visiting and sketching in the larger and more complete workshops round Calcutta.

24. The Lieutenant-Governor, Sir Richard Temple, accepted Colonel Hyde's views, and hoped that the matter would be set on foot as soon as practicable. Nothing, however, appears to have been then done towards the establishment of the workshops.

25. It should here be noticed that Colonel Hyde had already, in 1873, established a class in connexion with the Hare School, open two days a week at 5-30 P M., for giving instruction in drawing, free of charge, to apprentices, artizans and mechanics, whether European, East Indian or native. Executive Engineers having good men in their employ were requested to induce them to attend the class, where they were taught rough mechanical drawing with the use of scales, such as would be useful to them in their daily work.

26. In 1875 a Committee, which had been appointed by the Government of India, consisting of Colonel Gastrell, Colonel Hyde, Major Eckford, Mr. McGregor and Mr. Fouracres, reported on the question of a training school for skilled workmen in Calcutta. The question of apprentice mechanics for the Public Works Department was not taken up, because it was considered that the Dehree School would supply what was required for this purpose The proposals of the Committee (which were practically those of Colonel Hyde) were confined to children of respectable European and Eurasian parentage, who should be apprenticed yearly, 15 to the Mint, 15 to the Dockyard, 5 each to the Mathematical Instrument Department and the Telegraph Department, and 3 each to the Engineering, Lithographic, Photographic and Drawing Departments of the Surveyor-General's Office, and to the Medical Store and Cutlery Departments. These 55 apprentices, after passing such a preliminary examination as each department might require, were to be boarded and lodged in a home in Calcutta, the cost to be met, so far as might be possible, by the actual earnings of each apprentice In the home the apprentices were to learn drawing, but nothing else. The home was to be under a Superintendent on Rs. 300, and an Assistant Master on Rs. 200; and it was calculated that the maintenance and clothing of each apprentice would amount to Rs. 40 a month On the other hand, the value of his earnings extended over five years would average not less than Rs. 33 a month; consequently the net cost to Government for each apprentice would be about Rs. 7 a month. For that outlay Government would obtain in this country a number of well-trained men to serve as supervisors or foremen of works of various kinds. The estimated earnings, however, seem to have been over-rated.

27. To questions put by the Government of India, the Government of Bengal replied—

(1) That apprentices should be taken from 15 to 17 years of age.
(2) That the qualifying test for apprenticeship should be (as at Dehree) reading, writing and arithmetic, with a preference to those who knew elementary algebra and geometry.
(3) That no preliminary test in language is necessary, but that a colloquial knowledge of Hindustani should be required of boys leaving the school.
(4) That the term of apprenticeship should be four years
(5) That apprentices would be employed (so far as regards the Irrigation Department) in working and keeping in repair portable engines, hoists, mortar mills, and the machinery of small branch workshops. They would also gain some knowledge of carpentry and foundry work
(6) If a boy was to acquire a certain amount of practical skill in fitters, founders, and smith's work, and also in carpentry, his earnings during apprenticeship would probably not exceed Rs. 10 a month all round.
(7) After their time expired, there would be employment for only a few mechanical engineers, with salaries varying from Rs 60 to Rs. 200 a month.

28. On the occasion of the visit of His Royal Highness the Prince of Wales to Bankipore in January 1876, the native gentlemen of Behar subscribed sums amounting to Rs. 2,00,000, which it was proposed to devote to the establishment of an industrial school at Bankipore. Half a lakh was to be spent in plant, and the remainder, yielding an income of Rs. 6,000 a year, to be devoted to the maintenance of the school; and Government undertook to supplement that income by a grant to an equal amount. The subscriptions actually realized, however, amounted to only Rs. 42,000, now in the hands of the Commissioner of Patna, and yielding an income of Rs 140 a month. It was very doubtful whether with that sum an industrial school could be started with any prospect of success Government, however, offered a grant of Rs 250 a month in addition to the local income, and proposed the establishment of a school under a European foreman from Dehree on Rs 200 a month and a teacher of drawing and mechanics on Rs. 50, together with two native carpenters and two native blacksmiths The course of study and of handiwork was not defined, but it was understood that theoretical and practical instruction were to be combined Scholarships were also contemplated; not necessarily for pupils of the artizan castes, but rather as an inducement to boys of higher castes to forsake their ordinary pursuits and betake themselves to handicrafts. The amount set aside for apparatus and plant was only Rs 1,500. This proposal to educate dilettante mechanics without shops came to nothing, and the money is still lying idle.

29. In December 1877 the Lieutenant-Governor suggested the application of the money to the foundation of scholarships tenable by natives of Behar at the Dehree School. It was not known whether the subscribers would consent to the amalgamation of their funds with a separate Government institution, and to its transfer from Bankipore; but Colonel Haig drew up a note on this basis. His proposals were as follows :—

(1) To throw open the school to all European and Eurasian boys able to pass the preliminary examination and willing to pay the full fee of Rs. 20 a month.

(2) To grant from the Bankipore fund scholarships of Rs. 8 a month, tenable at the Dehree School by Behari boys.

(3) To make an additional grant of Rs. 8,000 or Rs. 10,000 in the Education Department for the establishment of scholarships, tenable at the Dehree School by European and native boys from selected schools throughout Bengal.

30. About the first proposal the only difficulty that was likely to arise was the want of candidates. At the examination of 1877, for 24 stipends of Rs. 15 a month, only 36 European candidates appeared, and of these only about 24 were found qualified. It was therefore doubtful whether any large number of European boys would be found willing to enter the school on payment of the full fee. It should be added, however, that boys of this class, paying the full fee, were not to be bound apprentices

31. With regard to the Behar scholarships, Colonel Haig pointed out that not a single Behari had as yet attempted to enter the Dehree School, all the native pupils having come from Bengal. The reason of this he could not explain, unless it was that boys were not sufficiently educated in Behar to pass the test. The true reason is that they are not advanced enough. There are hundreds of middle class boys in Behar, educated to the requisite standard; but they belong to the literary classes, and will not at present stoop to manual labour. Colonel Haig proposed that picked boys from the lower school should be taught English and drafted to the upper school; but this would, in the first place, do nothing towards the technical education of the class whom we wish specially to influence; and in the second it could only be carried out by taking a boy who was already learning a trade and who promised to become an efficient workman or even foreman, and training him for an Overseer's post A good workman, however, is just as valuable in his own line as a good Overseer.

32. The third proposal, namely, to attach to the school a number of scholarships to be awarded to pupils all over Bengal, has been superseded by the later proposal to set up separate workshops and schools in Calcutta, for the consideration of which the present Committee has been appointed.

33. The course of instruction at Dehree has recently been revised, and, the standard raised, apparently in consequence of orders from the Government of India, that the course should be such as to fit the boys for the position of foremen mechanics rather than for that of Overseers in the Public Works Department. The standard, which is in some respects higher than that for the Overseer grade, comprises the following subjects :—

I.—*Mathematics.*—Arithmetic, algebra, euclid, mensuration, plane trigonometry, statics, dynamics, hydrostatics.

II.—*Natural Sciences.*—Chemistry, experimental physics, physical geography.

III.—*Drawing.*—Orthographic projection, practical geometry, freehand drawing, and drawing of machinery.

IV.—*Mechanical Engineering.*—Estimating, applied mechanism, strength of materials, mechanism, the steam-engine.

34. The foregoing course occupies 22 hours a week in school, and 27 hours a week are also spent in the workshops. That is to say, Saturday being a half-holiday, the boys spend four hours a day in school and five hours in the shops. The term of apprenticeship lasts for four years, during which they pass through all the shops in succession. At the end of their

course they are examined for the certificate of foreman mechanics in the subjects detailed above, and also in the practical course prescribed for Whitworth scholarships. This practical examination includes (1) tools and their uses, in which the pupils have, then and there, to set and use the axe, the saw and plane, the hammer and chisel, and the file; (2) the forging, welding, and making of tools; (3) the fitting and erection of machinery, such as derricks and steam-engines In all the subjects of examination a total of 2,400 marks is set—1,400 for the theoretical part, and 1,000 for the practical—and in order to secure the certificate of a foreman mechanic, a candidate must obtain half marks in the practical branch, and half marks in the total.

35. The value of the plant at the Dehree Workshops is estimated at about Rs. 2,00,000. The monthly cost is as follows for 52 pupils—

49 European apprentices, at Rs.	15	...	...	...	Rs.	735
3 Native „ „	7	...	...	..	„	21
4 Foremen's fees „	50	...	.	...	„	200
Garden establishment ...		...	...	...	„	24
Medical establishment and contingencies			...	...	„	283
School contingencies ...		...	...	...	„	195
Monitor of discipline ...		...	..	...	„	24
School-master		...	...	...	„	250
Executive Engineer's allowance		...	...	...	„	150
			Total	...	„	1,812

From this must be deducted the value of the work done by the boys, estimated at Rs. 7-8 a month each, or for 52 boys a deduction of Rs 390 must be made. This gives the net monthly cost of the school as Rs. 1,422, or Rs. 17,064 a year, exclusive of the interest on the amount laid out in buildings.

36. The foregoing sketch of the attempts hitherto made to establish systems of technical instruction may serve to show the present Committee in what directions action is likely to be useful. The Committee was appointed in January 1878 with the object of considering and reporting on the measures necessary for establishing a practical training institution for engineers, in connexion with the workshops which it was proposed to establish at the Presidency for all the requirements of the Public Works Department. It was pointed out that passed students of the Civil Engineering College, both scholarship-holders and others, were already receiving practical instruction in the existing workshops and in the Akra brick-field; and also that a considerable portion of the native community had shown an unmistakeable desire to obtain the means of acquiring practical instruction in mechanical (as distinguished from civil) engineering. The necessity of providing for the middle classes other careers than those now open to them was referred to; and it was proposed to establish scholarships, both for Europeans and Eurasians and for natives, which should be awarded to pupils of selected schools throughout Bengal, and should be tenable at the institution whose establishment was to be considered. The Committee were also to consider whether it would be advisable to remove the Civil Engineering Department from the Presidency College, so as to work the two branches together as one institution for giving a complete technical education and training for engineers.

37. Throughout the resolution nothing is said about training either mechanics or foremen. For the training of mechanics there is only one course open, namely, that of apprenticeship in a shop by the side of a good workman, the man (as Colonel Hyde says) "who will outwork any man under him," and to give him such instruction in drawing and figures as will fit him to take the lead of a shop while he still remains a man of a single trade. Or, if the shop be a large one, requiring a foreman of special intelligence and resource, then one trained in the next higher grade, as an Overseer and not merely as a tradesman of a single craft, may be made foreman. There is no difficulty in training good journeymen or good foremen Given actual workshops of sufficient size and plant; given a system of apprenticeship for sons of Lohars and Kurmokars or poor Christian boys who can read and write; given a night school for teaching good workmen (not confined to those in Government shops) to draw and calculate; and you have all the direct provision that is necessary for training mechanics and foremen. The amount of instruction thought to be necessary varies from "rough mechanical drawing with the use of scales," as in Colonel Hyde's school, to arithmetic, geometry, drawing and mechanics, according to Captain McNeile. The latter gentleman says:—"I do not think a man can be a really good mechanic if he does not know something of the theory of mechanics, as about the lever, system of pulleys, &c.;" and, he adds, that foremen of this class would improve their respective trades and the work of the men in their shops. The importance of making this provision, and thereby of improving the standard of mechanical work throughout the country, can hardly be over-rated, and it ought to take a forward place in any scheme for technical training, but it will do nothing towards providing technical instruction for the middle classes, and it is not the immediate object of the Government Resolution.

38. The object of that Resolution is, in fact, to provide a new career for the middle classes, in a way which shall be at once profitable to themselves and useful to the State. In

other words, the object is to train up a class of Overseers and Engineers in the branch of mechanical engineering, corresponding to the class of Overseers and Engineers trained at the Presidency College for the branch of civil engineering, *i.e.*, work connected with houses, roads and bridges. And it is necessary to repeat that the term fore man mechanic, used at Dehree, seems to be a misnomer ; because the men are trained, not to be mechanics, but to be Overseers, and because they sacrifice proficiency in a single trade in order to acquire that practical familiarity with several branches which will fit them effectively to supervise and conduct large factories or shops in which many different kinds of work are going on.

39. As regards the course in the Civil Engineering College, no complaint has, I believe, been raised against the character or the amount of the theoretical instruction given to the engineer students. But it is urged that their training fails on the practical side ; they are good surveyors, but they are not (except the few scholarship-holders) brought necessarily, and as a part of their course, into close and actual contact with the practical operations that they will have to conduct as soon as they enter either the department or private employ.

40. The training for the Overseer grade, the standard for which is simply two-thirds of that prescribed for Engineers, is condemned on the ground that a bad Engineer does not necessarily make a good Overseer. For an Overseer is required, above all things, a man who, knowing practically what good work is, has the power to get it done. Some men have more of this power, some less ; education counts for something, but moral qualities, such as energy and force of character, for much more. But the essential condition is that an Overseer should know good work and detect bad work; and in order to do this he must labour with his own hands at as many branches of work as he will be called on to supervise. It follows then that the first provision to be made is the opportunity of learning practical work, the point insisted on in Mr. Leonard's note of 1868. Those who are being trained for Overseers should go on survey parties, as they now do ; they should be drafted to works in progress, learn to use plans, frame estimates, keep accounts, and manage work-people ; and they should also go into the shops for such actual training in wood and ironwork as may be required in their profession. In order to secure these results the theoretical training must be largely curtailed, in strict accordance with Mr. Leonard's principle that the students need " learn nothing more than will make them useful as Overseers, leaving all scientific work to be done by Assistant Engineers." The theoretical course suggested by Mr. Leonard is probably too slight, just as the corresponding course at Dehree (for the mechanical branch) is probably too severe : between these two limits the mean may without difficulty be determined.

41. The training for Sub-Overseers is condemned on every side as an anomalous attempt to made theoretical knowledge do the work of practical skill. The proper duty of a Sub-Overseer is that of a foreman ; he ought to be the best among a number of workmen, and should be selected and styled in conformity with the true character of his position, which is that of an artizan of exceptional intelligence and skill.

42. The possibility of setting on foot an institution for training Overseers and Engineers in the mechanical branch, through a course corresponding to that for training men of the same grades in the general branch, depends upon the independent establishment of workshops that will pay, and that are extensive enough to afford the necessary instruction On this point Mr. Isaac believes that, when the new shops are set up, work to the amount of four lakhs of rupees a year may be expected. The present shops were established in 1876; and the total amount of work executed in them during the year 1877-78 was little short of two lakhs. The new shops will be able to execute repairs to dredgers and mud-barges, to construct new barges for the Calcutta Canals Division, and to undertake much of the work of the new iron lock-gates and bridges; and the work on this account will be not less than Rs. 50,000 a year for the next three or four years. Repairs to provincial steamers and launches will supply another item of work. Further, if the Bengal Government pass the necessary orders, it may be anticipated that work to the amount of half a lakh will come in from district roads. Lastly, there is every probability of a large amount of work being required for provincial railways, in the construction of bridges and manufacture of carriages. On the whole, Mr. Isaac is of opinion that the shops should be constructed on such a scale as to turn out Rs 4,00,000 worth of work annually, and to admit of extension. It will of course be understood that neither provincial railways nor district roads will employ the shops unless they can turn out work as quickly, as cheaply, and as well as private firms.

43. The establishment of shops on a sufficient scale being assumed, it remains to consider the course of instruction, both theoretical and practical, required to train young men for the position of Overseer and of Engineer respectively. Existing models which it may be useful to examine are, for Overseers, the Imperial Schools of Arts and Trades at Chalons, Aix and Angers ; and for Engineers, the Central School of Paris. The subjoined accounts of these institutions are taken from a report on technical instruction presented to Parliament in 1869.

44. The Schools of Arts and Trades are intended to train men to become Overseers of shops and factories and managers of works. The age of admission is 15, and the qualifications are reading, writing, arithmetic, algebra to equations of the second degree, four books of euclid, elements of trigonometry and of drawing, and outlines of history and geography. Another condition (which could not be demanded in India) is that the candidate should have served for a year as an apprentice to a trade ; and he is accordingly required to go through a manual exercise in his trade in the presence of a practical man. The course of instruction occupies three years ; the pupils work six days a week for 12 hours a day—5 hours being spent in school, and 7 hours in the shops. The number of pupils is 300, 100 being admitted each year.

45. The theoretical instruction is shown in the following extract—

"In the first year the professor goes rapidly through the programme of admission, thus systematizing the different methods learned elsewhere before proceeding with the same subjects. He takes his pupils in the first two years through mathematics proper, during which he teaches them arithmetic, algebra as far as and including quadratic equations, elementary geometry comprising curves of the second degree demonstrated geometrically, plane trigonometry, the elements of descriptive geometry, and kinematics or geometrical mechanics.

"In the third year a professor teaches industrial mechanics, including hydraulic machines and steam-engines; of physics, the principal general elements and in considerable detail; lastly, a few elements of chemistry, the nomenclature, and what bears more specially on materials. Numerous practical applications varied for each pupil exercise the pupils in mechanics. The repetitions or interrogations are made by the professors and by foremen of the workshop.

"Drawing is taught very simply. In the first year the pupils, to get the free use of their hands, make designs with the drawing-pen comprising all the principles of symmetry, of joining curves, &c., which they will require later when they come to draw machines. Most of these exercises are taken from architecture, of which the pupils also learn some of the elements. For this part only, the drawings are copied from models. Geometrical drawings, designs of joints in carpentry and joinery, elementary exercises in drawings tinted with India ink and dull colours, as well as two drawings of plans, complete the first year's studies.

"In the second year, first the elements of machine drawing; next come in the hours of study, working drawings of descriptive geometry which require the most rigorous accuracy. On reaching this point the pupils, having acquired neatness, clearness, accuracy and precision, should be able to draw well. They immediately apply these principles to the geometrical drawing of machines, of gearing, &c. In the second year the pupils in the workshops, in their drawing lessons, make sketches of tools and various machines to scale with dimensions given. In the third year they make drawings of machines and those relative to the lectures on mechanics. They also calculate the principal parts of the machines they represent. They conclude with making drawings of machines in plain tints."

46. The practical instruction is given below. About 30 pupils work in each of the preparatory shops, the pattern-shop, the foundry and the smithy, while some 200 work in the fitting shop—

"*The Pattern shop.*—The pupils begin with making simple patterns with boards; then each learns to execute all the different joints used by carpenters and joiners. Next come patterns for founders (proceeding to the most complicated and most difficult), gearing (straight or bevilled, with or without mortising), cylinders, and framework for steam-engines, &c. The pupils also make, but only as exercises in the handling and cutting of wood, and according to the demands of the country, articles of furniture more or less ornamented.

The Smithy.—They begin with welding scraps of old iron into masses, and making tongs and other tools used in forging. They next forge small articles for exercise in filing and fitting, and then parts of machines from the simplest to the most complicated. In the third year the pupils learn to use the steam-hammer.

"*The Foundry.*—They begin with plain castings of balustrades, palissades, medallions and the simpler part of machines, and then, as an exercise in detached ornaments, before executing them on a large scale, the pupils make small busts, statuettes, &c. As a general rule in this workshop, as in the fitting-room and at the forge, they begin with practice entailing but little expense of material. By degrees they come to the framework of machines, and the casting of large wheels either with cogs, or with mortise-holes to receive wooden cogs, and lastly, to the casting of steam cylinders, &c., according to the orders to be executed. All the operations of the workshop are performed by the pupils themselves, as making the moulds, charging the furnace, working the cranes, casting, paring and trimming.

"*The Fitting shop*—The pupils begin with simple pieces of regular forms, requiring great attention to symmetry and precision, and for that reason very instructive. For instance, they first make two small iron straight edges perfectly true in every sense; then two squares accurate in every respect; next with a piece of wrought iron they make a regular quadrangular prism and from it an octagonal prism; or a right cylinder to be afterwards turned into a hexagonal prism, &c. After this they make various kinds of compasses, hand and claw vices, keys for screws, ratchets, &c.; then bow-lathes, bench-vices, pulleys; and lastly, all the different parts of machines, according to orders on hand, machine tools, steam-engines, &c."

47. The following extract is also quoted, but it seems to show that in these schools the work to be done is subordinated to the instruction, instead of the instruction to the work. That principle is not essential to the system, nor should it probably be followed; for practical Engineers are agreed that the best technical school is an extensive and well-conducted workshop, and that the ordinary operations of such a shop afford all the opportunities of instruction that are required.

"The object is not to get as much money as possible by making the same thing over and over again, but to learn how to work well at all kinds of things, so that the pupil may be able to turn his hand to any branch of his trade where he may find an opening, and to fit him for entering any workshop, large or small, with a good store of practical knowledge. After one year's work, at most, in any specialty, a clever pupil will acquire all the rapidity of execution common to good workmen.

"The machine tools, planting, mortising and filing machines are seldom used by the pupils till they can work well with the hand; but the less skilful always have the advantage of seeing these machines in use, and, having been obliged to make drawings of them, must be well acquainted with their principles. Each pupil has a vice to himself, and at each bench there are pupils of all the three divisions, that the more advanced may teach the juniors. There are also in each shop one or two workmen as examples for the boys, and they are also employed when required to put up the machines made at the school for private manufactures."

48. The practical value, in a country like France, of the training given in the Schools of Arts and Trades is shown by the fact that of 465 pupils who left the schools in 1861 and 1862 after completing their studies, only two were known to be unemployed twelve months afterwards. The bulk of the pupils were employed at the outset as overseers and foremen in various factories, workshops and railways; others as designers and draughtsmen; and others, again, as marine or road engineers. Of 644 ex-pupils who have been engaged in the active business of life for many years, 106 were heads of establishments working on their own

account (in the construction of machines, in iron works and in foundries), 71 were civil and mechanical engineers, 141 were foremen of factories and shops, 159 railway officials, 78 designers in manufactories, 20 chief and assistant engineers of bridges and roads, &c.

49. The Central School of Paris was founded with the object of strengthening the manufacturing industry of France against foreign competition It was not enough to possess good workmen and intelligent overseers: skilful engineers were likewise wanted. Manufacturers, again, felt the necessity of acquiring and obtaining for their children that theoretical knowledge without which they were unable not only to direct their establishments themselves, but also to control their managers. It was believed that the schools of Chalons and Angers, though supplying the workshops with excellent overseers, did not impart that accurate and extensive instruction which is necessary for the directors of large manufacturing establishments, and indispensable for civil and mechanical engineers. The outcome and practical value of the instruction are shown by the following facts At Paris, in 1865, the chief engineers of the rolling-stock and locomotive departments of the four great railway companies belonged to the Central School. There were also 28 chief engineers of railways with salaries from 20,000 to 70,000 francs a year, and 135 ordinary engineers of railways with salaries of from 5,000 to 20,000 francs, all of whom were pupils of the Central School. Civil engineers in general practice numbered 166; ironmasters, mining superintendents, &c., 124; manufacturers and spinners 111; architects 55; mechanical engineers 54; manufacturing chemists 38; managers of gas works 31; engineers of bridges and roads in foreign countries 22; manufacturers of glass and porcelain 22; and so on.

50. At the Central School all pupils, whatever be the career they have chosen, are obliged to attend all the courses, and to pass strict examinations in every subject. The pupils are thus prepared to follow almost any industrial profession; and it often happens that pupils after leaving the school pursue with success a different career from that originally chosen. In this respect the Central School differs from similar institutions founded on its model in other countries, where alternative courses are set for pupils destined for different professions. The course of study in the Central School occupies three years. In the first year the instruction is theoretical only; in the second and third theory and practice are combined. Pupils are admitted at 17 or 18 years of age, and each pays a fee of 800 francs a year for his instruction.

51. The following programme shows the course of studies in detail—

"*First year.*—Analysis, comprising the differential and integral calculus and general mechanics, 60 lessons; general physics, 60 lessons; inorganic and organic chemistry, 60 lessons; theoretical and applied kinematics, 24 lessons; construction of machines, 20 lessons; hygienics and applied natural history, 20 lessons; mineralogy and geology, 30 lessons; architecture, 10 lessons; industrial drawing, 20 lessons.

"*Second year.*—Applied mechanics, 60 lessons; strength of materials employed in machines and constructions, 24 lessons; construction and mounting of machines, 60 lessons; analytical and industrial chemistry, 40 lessons; metallurgy, 20 lessons; civil constructions, 60 lessons; industrial physics, 45 lessons; industrial and commercial legislation; ceramics, 8 lessons; dyeing, 12 lessons; glass-making; mining 20 lessons.

"*Third year.*—Applied mechanics, 60 lessons; construction and erection of machines, 55 lessons; analytical chemistry, 20 lessons; industrial and agricultural chemistry; general metallurgy and metallurgy of iron, 60 lessons; mining 20 lessons; public works, 60 lessons; steam-engines 35 lessons; railways, 40 lessons; naval construction, 25 lessons.

"In addition the following practical exercises and studies are required—

"*First year.*—Various chemical manipulations; exercises in general physics, stereotomy and taking of plans; architectural and topographical designs and working drawings; problems in the infinitesimal calculus, general mechanics and general physics. In the course of the year the pupils all undergo 27 examinations on the different branches of study, and a general one at the end of the year. During the vacation after the first year's studies, the pupils are expected to make plans of buildings and machines; also to write an essay on the resistance of materials.

"*Second year.*—A practical study of the flow of gases with the aid of an anemometer and a ventilator; each pupil to draw up a paper on the subject. Construction with bricks, according to given plans, of various chimnies, a baker's oven, a lime kiln, a hot-air stove, &c. Each pupil to make a survey and draw a plan of a water-course, and to measure the volume of water in a stream; a paper to be sent in upon the details of these operations. Practical exercises in a factory on the construction of machines. Twenty-seven manipulations in analyzing and assaying. Drawings and projects of machines and buildings. Each pupil passes 21 examinations on the different objects studied, besides the general examinations at the end of the year. During the vacation, after the second year, the pupils are to visit manufactories, &c., and to hand to the Director, on resuming their studies, a diary giving a summary account of the studies made and the factories visited, an album containing notes and sketches made on the spot; fair drawings of the most remarkable objects contained in the album, and a paper on questions of applied mechanics.

"*Third year.*—Projects, in two series. The first in the more important subjects of all the courses, and comprising four different studies, required from all the pupils of the division. The second belongs exclusively to specialties, and consists of four projects on subjects connected with machines, buildings, metallurgy and chemistry.

"All pupils of the third year who have satified the requirements of their division are admitted to this competitive project. The work consists of a complete study of the questions connected with a given project belonging to their specialty; it comprises numerous drawings with written explanations. The pupils of the third year undergo 20 examinations during its course, besides the general ones at its close."

52. In most of the Polytechnic Institutes of the Continent the course of study, as before mentioned, is divided into various branches, and each pupil follows that which corresponds to the profession he has chosen. The divisions are generally as follows—

Surveyors.	Mechanical engineers.
Architects and builders.	Mining ditto.
Engineers of bridges and roads.	Foresters.
Railway engineers.	Agriculturists.

Manufacturing chemists.

In most cases the earlier part of the course is common to all divisions, and pupils break off to their special studies after the first or second year. The courses occupy from three to five years, and are often so arranged that those who do not aspire to the highest posts can finish their training before the completion of the entire course, with a body of knowledge and practice fully qualifying them for subordinate positions.

53. The Polytechnic School of Hanover may be taken as a good example of its kind. All pupils alike attend the "Preparatory School" for one year. For admission to the Preparatory School the candidate, who must be 16 years of age, is required to write an exercise in his own language, and to know proportion and decimals, the elements of algebra and geometry, and the outlines of geography and history. The programme of the Preparatory School is:—Elementary mathematics, algebra as far as equations of the third and fourth degree; elements of geology and botany; elements of mineralogy; free-hand drawing; linear drawing; elements of descriptive geometry.

54. The order of studies in the special branches is as follows:—

For Surveyors.

1st year.—Preparatory school.

2nd year.—First course of higher mathematics; theoretical and applied physics; descriptive geometry.

3rd year.—Practical geometry with drawing of plans; geology and physical geography.

For Architects.

1st year.—Preparatory school.

2nd year.—First course of higher mathematics; technology; descriptive geometry; mechanics; theoretical physics.

3rd year.—First course of construction and ornamentation; practical geometry and drawing of plans; general knowledge of machines; modelling; drawing from the cast.

4th year.—Second course of construction and ornamentation; physical geography; construction of roads and railways; modelling; drawing from the cast.

5th year.—Third course of construction and ornamentation; bridges and hydraulic constructions; theoretical chemistry.

For Civil Engineers

1st year.—Preparatary school.

2nd year.—First course of higher mathematics; technology; descriptive geometry; mechanics; theoretical physics

3rd year—Second course of higher mathematics; first course of construction; practical geometry and drawing of plans; construction of machines.

4th year.—Second course of construction; physical geography; roads and railways; higher mechanics; applied physics.

5th year.—Third course of construction; hydraulics and construction of bridges; special mechanics; theoretical chemistry.

For Mechanicians.

1st year.—Preparatory school.

2nd year.—First course of higher mathematics; technology; descriptive geometry; mechanics; theoretical physics.

3rd year.—Knowledge of machines; construction of machines; first course of construction; higher mechanics.

4th year.—Knowledge of special machines; second course of higher mathematics; theoretical chemistry; applied physics

For Agriculturists.

1st year.—Preparatory school.

2nd year.—Theoretical chemistry; technology; physics; mechanics.

3rd year.—General knowledge of machines; first course of building construction; practical geometry and drawing of plans; or else chemical manipulation and practical chemistry.

For Chemists.

1st year—Preparatory school.

2nd year.—Theoretical chemistry; technology; theoretical and applied physics and mechanics.

3rd year—Geology and physical geography; or else general knowledge of mechanics and applied chemistry.

4th year.—Chemical manipulation

55. An examination of the foregoing programmes will make it clear that theoretical instruction is carried to a high standard, while there is often little or no provision for practical training. The pupils of the Central School at Paris do not, like those of the Schools of Art and Trades, devote a part of their time to manual operations in the workshops, though many, after leaving the schools, pass a year or two in a good workshop, executing all kinds of work with their own hands.

In the Polytechnic School of Prague somewhat fuller provision is made for practical training. In the branch of Mechanical Engineering, the course for the fourth year comprises practice in the workshop, besides visits to great manufacturing establishments; while the whole of the

fifth year is devoted to workshop practice. In the branch of Civil Engineering the coures comprises geological excursions, practical stone-cutting and modelling, and visits to remarkable engineering works. In the Carlsruhe Polytechnic, which is regarded as one of the best in Germany, civil engineers go through 'exercises in practical building' every afternoon in winter, and both morning and afternoon in summer; while mechanical engineers have practice in the workshops' every day from 4 to 6 P M. throughout the last two years of their course In the Dresden Polytechnic those who are being trained as mechanical engineers pass two years in a workshop after the completion of the first year's course; and many finish their theoretical training at that point. Those who return for a further period of two years' study lie under the disadvantage of having forgotten much of the earlier course; but it is found that many of them become distinguished engineers. The same result is shown by the success of those pupils of the Schools of Arts and Trades who afterwards finish their studies at the Central School of Paris.

56. Still, in all the foreign institutes, the course of instruction is governed by the principle of developing to the highest possible extent, during the period of study, the scientific faculties of a student rather than his practical aptitudes; and even where workshops exist, they are often mere appendages to the school, kept up for purposes of illustration. The period of life from 16 years to 21, which a French or Bavarian student of mechanical engineering spends in the class-room, is passed by an English lad, destined for the same profession, in the workshop as an apprentice or pupil to an engineer. At 21 the Englishman is a skilful workman, with plenty of valuable experience, but very ignorant of the scientific side of his profession; while the Frenchman, with his mind stored with knowledge of more or less practical applicability, has never seen a bolt driven or taken a file in his hand

57 The following extract from a paper of suggestions made to the Council of the Institution of Civil Engineers by Sir John Rennie, F.R.S., fairly illustrates current English opinion:—

"Any person intended for the profession of a civil engineer, in my opinion, should be educated as follows:—In the first place, he should be sent to some good school until about 12 years of age, where he may be thoroughly grounded in reading, writing, composition, arithmetic, algebra, geometry, English, Latin, and Greek grammar. I mention the two latter as it will enable him hereafter to acquire with facility European or other languages as occasion may require, particularly French, German, Italian, Spanish, &c.

"From about 12 to 16 he should be sent to one of the junior universities, such as King's College, the London, Edinburgh, Glasgow, or Dublin Universities. Here he should attend the different classes of mathematics, algebra, geometry, plane and spherical trigonometry, astronomy, natural philosophy, geology, geography, chemistry, electricity, and drawing, assisted by private tutors, who, by frequent examinations, should make him thoroughly understand what he has learned, and enable him to pass with credit the several public examinations which he must undergo.

"At the age of 16, if he has been diligent and well looked after, he ought to have obtained a sound general education, particularly as regards the scientific department connected with the profession of a civil engineer.

"At 16 he should be apprenticed to some practical manufacturing engineer of eminence, where he should commence working with his hands, and go through all the departments of pattern-making, founding, turning, fitting and erecting steam-engines, marine, locomotive and fixed, and all variety of machinery connected with them and railways, and general knowledge of ship building, whether of iron or wood; also the mechanical drawing and calculating departments connected with them.

"After having been well employed in this manner for three or four years, combined with his previous education, he ought to be well versed, or grounded at least, in mechanical engineering, which forms one of the most important parts of the education of a civil engineer.

"Having completed this, he should be sent to some good scientific and practical nautical and land surveyor for a short time, where, if diligent, he will soon be able to acquire a knowledge of levelling, laying out lines of roads, railways, canals, drainage, and mapping large districts of country and sea coasts.

"He should then study practical hydraulics upon a great scale, such as the principles and management of rivers, embanking, draining, sewage, water-supply, irrigation, the planning and construction of harbours, docks, bridges, light-houses, masonry, carpentry, earthwork, &c., with a thorough knowledge of the use and best mode of applying materials of all kinds; and having previously obtained a knowledge of working iron and timber, he should do the same with stone, cements, and other materials. He should likewise practice himself in drawing up detached reports, plans, specifications and estimates of the various works In these departments he will be greatly assisted by reading and carefully studying the reports and plans of Smeaton, Telford, Stephenson, Brunel, Watt, Rennie, and other eminent engineers.

"He should also study architecture, so as to be able to design and construct all the buildings connected with civil engineering, such as railway stations, sheds and warehouses.

"Public buildings and ornamental architecture, strictly speaking, are rather out of his line; nevertheless, if he has time and taste for it, he can do so at his leisure.

Sir John Rennie adds that it is desirable for an engineer to know well German, French, and Italian; and that, having previously laid the foundation of them in Latin, he will have no difficulty in acquiring them at his leisure The higher branches of physics and mathematics, though not absolutely necessary for the practice of civil engineering, he regards as a most valuable accomplishment for those who have the time and taste to acquire them.

58. There can be no doubt that, on the practical side, the training sketched by Sir John Rennie leaves nothing to be desired in the education of a civil and mechanical engineer. Nor probably is there any fault to be found with the theoretical training, provided only it can be secured. But any one who knows what the ordinary standard of a boy's education at 16 is can see that the course imagined for him by Sir John Rennie is quite unattainable. Nevertheless, I understand Sir John Rennie to mean that, whatever the lad's school acquirements may be at 16 years, his apprenticeship should not be postponed beyond that age. It will follow therefore that, at the age of 22 or 23, the young engineer will enter on the practice of his profession with hardly a trace of that scientific education which Sir John Rennie still regards as essential. In this respect the foreign system seems to have the advantage. The foreign engineer will by degrees, as he follows his profession, acquire the

practical skill with which the young Englishman starts; the English engineer will not, except in rare instances, make up for the defects of his scientific education. I assume indeed, as Sir John Rennie admits, that this scientific education is practically useful for an engineer, and is not merely an accomplishment which he may well do without if he finds no opportunity of acquiring it. I do not know how far this assumption is well founded; and in face of the fact that civil and mechanical engineers in England have generally been trained almost exclusively on the practical side, the need of a scientific education does not seem to have been much felt. But all the authorities acknowledge, in principle at least, the necessity of a fairly complete scientific training for young engineers; and it should be remembered that in the Royal Engineer Corps such a training is secured. Professor Fleeming Jenkyn's words on this subject may be quoted:—"Our defect is the want of a good knowledge of the theories affecting our practice. It must be admitted that of this knowledge we possess far less than is necessary. By dint of sheer hard thinking and repeated trials we somehow do solve most problems, but our success costs a vast expenditure of money and of brain, which could be turned to better purpose if we knew how to calculate the result to be expected from a given combination with some certainty beforehand."

59. A note, written in 1869 to the Institution of Civil Engineers, by Mr. J. M. Heppel states clearly the requirements of an engineer's education from the English point of view. The youth intended for that profession should first of all have acquired a good general education, modified by the requirements of his future career. "He should be a moderately fair classical scholar, and should understand French and German, and if also Italian and Spanish, so much the better. In English, besides a fair acquaintance with history and general literature, he should be able to express himself in speaking or writing with precision and force." He should further have "a sound knowledge of common geometry, so much of trigonometry and conic section as is usefully applicable in practice, of the nature and use of logarithms, of ordinary algebra and of the higher analysis, so far as the general principles and most usual applications of the differential and integral calculus; a complete acquaintance with the theory of statics, and so much at least of dynamics as will enable him fully to understand any ordinary treatise on the action of the chief motive powers, as gravity, water, or the various forms of heat. He should be fairly acquainted with chemistry, geology, physical geography, and most of those branches of science which are commonly grouped together under the name of natural philosophy." All this body of knowledge, Mr. Happel considers, could be attained by a boy of 16 at school, followed by one or two years' attendance at special lectures. "At least so much might be acquired that the rest might easily be made up by private study, concurrently with the subsequent pursuit of the more practical part." During this period, or after it, mechanical drawing should also be acquired, including the making of accurate and detailed sketches, with dimensions of machinery and works to be done to scale. The pupil should then give a year or two to learning some mechanical trade, as that of a smith or millwright, working full hours with the men and earning wages. He should also get a good practical acquaintance with the mechanical properties of the principal materials of construction, and a sufficient knowledge of the trades of a carpenter, bricklayer and mason, to be a competent judge of work. He is then fitted to enter as a pupil into an engineer's office, where, amongst other things, he must acquire a thorough knowledge of surveying, plan-drawing, estimating and account-keeping.

60. This method of training, the completeness of which cannot be doubted, Mr. Heppel prefers to that in vogue on the Continent, in which every detail of professional education is given in special colleges. As far as relates to the purely scientific part of the latter system, he considers that the course of instruction may be sound and complete; but he finds fault with practical training "The work is not real work. The plan of the bridge may be neatly and carefully drawn, its strength calculated, its cost estimated, and all this may be submitted to judicious criticism, but no body has got to build it. A survey may be made of the neighbourhood of the institution, or of a line of road or farm in its vicinity, and nicely plotted, but it has not got to pass a Committee on Standing Orders. A line of canal may be laid out and levelled, and a working section and detailed plans prepared, but it is exempt from verification by that most uncompromising examiner, water."

61. It appears then that we may err by excess of theory or by excess of practice. At the same time it seems quite possible to secure that amount of scientific training which Sir John Rennie and Mr. Heppel, in entire accordance with the principles of the Continental system, declare to be necessary to an engineer, provided only that we do not insist on its acquisition at an impossible age, and that we allow in the early years of the course theory and practice to go on together. If this be admitted, it would be a matter for practical engineers to determine what course of instruction, both theoretical and practical, would be most serviceable to pupils. In suggesting the following courses, I merely wish to fix a definite basis for discussion. In drawing them up I have consulted the English and French standards before referred to; and I have also borne in mind the suggestions made to the Committee by Mr. Isaac, which are shortly these:—That a five years' course be fixed for engineers in the two branches of Civil and Mechanical Engineering, and that the first four years be given to theory and practice, the fifth to practice only; that a five years' course be likewise fixed for overseers, civil and mechanical, and that the first three years be given to theory and practice, the fourth and fifth to practice only.

62. For the education of engineers, civil or mechanical, a five years' course is necessary. Pupils should be admitted at the age of 16 or upwards, and for this higher grade the University Entrance certificate should be required. The course for civil engineers need not differ

widely from that now prescribed, though in certain portions the latter needs to be strengthened. It might stand as follows :—

COURSE FOR CIVIL ENGINEERS.

I.—Pure Mathematics.

Arithmetic and algebra.	Trigonometry, logarithms and mensuration.
Plane geometry and conic sections.	Differential and integral calculus (elements).
Practical or descriptive geometry.	

II.—Applied Mathematics.

Statics and dynamics.	Hydrostatics and hydrodynamics.

III.—Physics.

General physics.	Physical geography, mineralogy and geology.
Chemistry and heat.	Telegraphy.

IV.—Drawing.

Isometrical, orthographic and perspective.

Mechanical drawing.	Plans and surveys.

Free-hand drawing.

V.—Architecture.

History of architecture.	Study of styles and models.

Acoustics.

VI.—Surveying and Engineering.

Practice of building.	Carpentry and mechanism.
Earthworks; roads and railways.	Strength of materials.
Hydraulic works.	Surveying and geodesy.

The subjects marked with an asterisk are new. Optics, which forms a part of the present course, has been omitted.

63. All this theoretical course should be got over in four years. The practical work in the first two years should be confined to the four shops, in which the pupils, working either daily or every other day, might go through the Whitworth course, namely, setting and using the axe, saw, and plane, hammer and chisel, and file; forging, welding and making tools; fitting and erecting machinery. Something short of this would, however, be probably sufficient for civil engineers. In the cold seasons of the second, third and fourth years the students should go on survey parties, doing the same kind of practical work as they now do. The last year should be spent partly in the Akra brick-fields and partly on works in progress, in which a certain amount of work and responsibility of various kinds should be given to the pupils, and in which they would have an opportunity of learning masonry, brick-laying, cement, &c, as well as the management of work-people and accounts. The practice of the Central School in Paris might also be followed. Every month the pupils who have arrived at a certain stage of their course receive a short specification of a certain work to be designed. The designs, specifications and estimates are to be ready by the following month The pupil can consult any authorities he pleases, but he is bound to produce an original design, making his drawings in the class-room. After the design is complete, the professor cross-examines every pupil as to his reasons for choosing the dimensions, materials and forms adopted, and finally criticises and corrects the design.

64. The course for mechanical engineers need not differ very widely from that for civil engineers.

COURSE FOR MECHANICAL ENGINEERS.

I.—Pure Mathematics.

Arithmetic and algebra.	Trigonometry, logarithms and mensuration.
Plane geometry and conic sections	Practical or descriptive geometry.
	Differential and integral calculus.

II.—Applied Mathematics.

Statics and dynamics	* Energy and work.
Kinematics.	Hydrostatics.

III.—Physics.

Chemistry and heat.	Mineralogy.
Electricity and magnetism.	Telegraphy.

IV.—Drawing.

Free-hand drawing.	Architectural drawing.
Mechanical ditto.	Geometrical projection.

V.—Mechanism.

Mechanical technology.	History of inventions.

VI.—Machines and Engineering.

Prime-movers and steam-engines	Strength of materials.
Hydraulic machinery.	Metallurgy.

Designs of factories.

The subjects here marked with an asterisk are those in which the mechanical differs from the civil engineering course.

65. The pupil should work for at least two hours every day in the shops, and become expert in the use of all forms f hand and engine-tools, and in the fitting and erection of machinery. His experience in this latter branch will depend upon the nature of the machinery used or manufactured, and would of course be much more extensive and valuable should the shops be employed in manufacturing locomotive and marine engines, with the large forgings and castings required for these purposes as well as for heavy girders, boiler-plates, &c. During one cold season at least he should work on a survey party. During his course he should be frequently exercised in designs of machinery, with complete drawings, specifications and estimates. If he could be deputed during his fifth year to some large engineering work in progress, in which he might have some definite occupation and responsibility, so much the better.

66. Should these courses be adopted, or any which, like them, involved changes in the present University standards, it would be necessary to ask the Senate of the University to modify its examinations accordingly. To this it would probably oppose no objection, though it might not consent to include practical work among its subjects of examination.

67. For the lower grade, that of overseers in either branch, it is probable that a four years' course would be sufficient, even though the last year should be spent on works in progress. Students of the overseer class require to earn their living as soon as possible. The present two years' course for candidates who have passed the Entrance examination is too short, and affords no opportunity for practical training. A five years' course seems to be unnecessarily long. I should even prefer a three years' course, if the proper kind and amount of training could be ensured. Mr. Leonard thought that a course of three years would be sufficient, of which only one year was to be passed in school and two at actual work; and he distinctly said that the standard of first admission to the department must be lowered, as it would be too much to except the same theoretical knowledge as is now exacted, and a good practical training as well The standard that he desired was "simple surveying, plan drawing and estimating, and easy practical mechanics." At the Schools of Arts and Trades, with a somewhat higher standard of admission than is proposed below, and also with a more advanced course of instruction, a period of three years is found sufficient, the whole time being divided between theoretical and practical work. If a four years' course be approved, the last year being confined to practical work, such as an overseer has to carry out, candidates should be admitted at 17 years of age, and pass a qualifying examination in English, a vernacular language (colloquially), arithmetic, algebra to simple equations, and two books of euclid.

68. In the Civil Engineering Branch little change need be made in the present standard for overseers, always supposing it possible to combine that standard with the practical training which is after all of the first importance. The objection to the present standard is not so much that the theoretical instruction is too high, as that there is no practical training. The standard is as follows:—

I.—*Pure Mathematics.*

Arithmetic and algebra.	Geometry (to 11th book of Euclid).

Trigonometry and mensuration.

II.—*Applied Mathematics.*

Statics and dynamics.

III.—*Physics.*

Chemistry.

IV —*Drawing.*

Orthographic projection. Scales and figures.		Architectural drawing Topographical ditto.

Surveying.

Theodolite. Box-sextant.		Compass and plane table. Levelling.

VI —*Engineering*

Estimating and designing.	Construction.	Strength of materials.

The only subjects to which objection could be raised as being (on Mr. Leonard's principle) "too theoretical" seem to be statics and dynamics, and chemistry. Reducing the theoretical standard to a minimum, the parallelogram of forces and the mechanical powers should in any case be taught; and the professional members of the Committee will be able to say whether elementary chemistry, as given in Roscoe's book, and the 11th book of Euclid, are or are not of practical utility to an overseer.

69. For the Mechanical Branch the standard should be the same as for the Constructive Branch, the subjects only being varied wherever necessary. This principal has been followed in drawing up the Dehree course. Thus in subject IV (drawing) free-hand drawing and the drawing of machinery from models and actual machines are substituted for architectural and topographical drawing. In subject VI (engineering) construction is replaced by mechanism and the steam-engine Surveying might be replaced either (as it is at Dehree) by hydrostatics, physical geography, and the elements of physics, or preferably by some such subjects as metallurgy and hydraulic machinery. We here, however, reach the fact that a course which (or its equivalent) occupies two years in the Civil Engineering College, with a higher standard of admission, but with no concurrent practical training, takes under different conditions four years at Dehree. It is therefore to some extent doubtful whether it could be gone through in three years in the proposed school. At Roorkee nearly the same course (excluding chemistry) as that for the Public Works Department overseer grade is completed in two years; but there is no concurrent practical work.

70. The practical training for overseers would be much the same as for engineers in either branch. In the Constructive Branch there should be, during the period of study, some training in carpenters and smith's work, and much in surveying; and after that period was over a year should be spent in brick-making and in learning masonry, brick-laying, accounts &c., on works in progress. For the Mechanical Branch there should be, during the period of study, some training in surveying, and much in carpenters, smiths and fitter's work; and after that period was over the pupil should be put in charge of a definite portion of work, either in the shops or outside.

71. A class for the improvement of skilled workmen, corresponding to the "mistri class" at Roorkee, could easily be set on foot. The instruction should include practical geometry, geometrical drawing, estimating, mensuration and surveying, and the mechanical powers.

72. Should it be decided to remove the Civil Engineering Department from the Presidency College, and to combine it with the proposed institution for training mechanical engineers, an addition to the instructive staff would be required. The present staff at the Presidency College includes a senior and a junior professor of civil engineering, a professor and a lecturer in mathematics, and a professor of drawing. All these could be transferred to the new institution, where they would teach the engineer students in the two branches the subjects common to both. The professor of chemistry, who is also the professor of chemistry in the General Department of the college, could not be transferred; and a new professor of physical science would be necessary. This would involve a further expenditure of some Rs. 10,000 for fitting up a laboratory, with all requisite instruments and apparatus. For the professorship of drawing would be required an officer of superior qualifications, who should have studied architecture and be competent to teach free-hand drawing. For these two posts an addition of two officers to the graded list of the Education Department would be advisable. For practical instruction in mechanical engineering, and for the general control of the pupils and the arrangement of their work in the shops, it would be necessary to appoint an officer of the grade of Executive Engineer, throughly skilled in mechanical work, and with special qualifications for the management of pupils and workmen. Since the overseer students would now form a special class, requiring separate teaching, it would probably be necessary to appoint an officer on lower pay to assist in their instruction, as well as in that of the mistri class. The contingent allowance of the Civil Engineering Department, as shown in the margin, could be transferred to the new institution, probably with little increase. It would be necessary, however, in the first instance to incur considerable expense in providing the institution with a complete and varied collection of drawings, models of machines and constructions, geological and mineralogical specimens. In the Vienna

	Rs
Clerks and servants ...	1,200
Survey allowance	2,000
Model ditto ..	600
Miscellaneous	1,000
	4,800

Polytechnic, for example, the collections comprise "models of bridges, locks, &c.; of boats, vessels, carriages of all kinds, hoisting apparatus, and weighing machines; dividing machines of various descriptions, hydraulic machines and apparatus, water-wheels, turbines, water-pressure machines, stationary steam-engines, steam-hammers, apparatus and machines for raising water, balances, dynamometers, clocks, locomotives, steam-boilers; a handsome model of Stephenson's slide; steam-boats, steam-dredgers; instruments of natural philosophy, barometers, optical instruments; an apparatus for firing mines, electrical machines, &c. There is also a very extensive technological collection of raw products tools, and manufactures of all kinds Very numerous collections of well-executed drawings, pasted on canvas, are placed at the disposal of the professors for their lessons."

73. The institutions should be conducted as other Government colleges are, on the principle of fee payments for tuition In the General Department of the Presidency College the monthly fee is Rs 12; in mofussil colleges Rs 5; in the Medical College and in the Civil Engineering Department Rs 5. The fee of Rs. 5 might be fixed for the engineer classes in the new institution, and Rs 3 in the overseer classes. In the artizan or mistri class no fee should be exacted

74 In order to make the institution popular at the outset, liberal expenditure on scholarships might safely be proposed The number of junior scholarships, tenable for two years, now awarded annually to students passing the entrance examination of the University is 160,—10 of Rs 20 a month, 50 of Rs 15 a month, and 100 of Rs 10 a month. If an addition of two first grade, six second grade, and 12 third grade scholarships were sanctioned, tenable only in the new institution, the extra cost would be in the first year Rs. 3,000, and in the second and following years Rs. 6,000 If they were made tenable for four years, the cost would be Rs. 9,000 and Rs. 12,000 in the third and fourth years, respectively. This plan would probably be better than that of awarding senior scholarships, in smaller numbers but of greater value, to the best students of the second year classes, as is now done in the case of the senior scholarships on the result of the First Arts examination. But all scholarships should be held on the condition of diligence and sound progress both in theoretical and in practical work. For the overseer classes, in either branch, scholarships of Rs. 5 a month for three years would possibly suffice. Each such scholarship would finally cost Rs. 180, and if 30 were sanctioned, the cost would be in the three years Rs 1,800, Rs. 3,600 and Rs. 5,400 respectively. For the last year of the course, which would be occupied by students of both classes in practical work, it might be possible to employ them temporarily in the Public Works Department, paying them such subsistence allowance as the actual value of their services might entitle them to.

75 The income of the Bankipore Fund, amounting to Rs. 1,600 a year, might be devoted, should the subscribers consent to that course, to the foundation of scholarships for Behari boys at the Dehree School, at the rate of Rs. 8 a month each.

76. If boarding-houses were established, it would be necessary to provide two—for Europeans and natives respectively. In these houses the pupil should be maintained at a cost not exceeding Rs. 20 a month for the former class, and Rs. 8 for the latter. Boarders should pay for their own maintenance, and such of them as were scholarship-holders would of course find little or no difficulty. Those that were well-off might be allowed a higher scale of living on payment of the necessary charges. For others it might be possible to provide, in special cases, free boarderships, or grants-in aid of maintenance, as at Dehree; but this would practically amount to increasing the number of scholarships, and awarding them on grounds of poverty rather than of attainments

77. No mention has been made of alternative courses for the instruction of mining engineers or foresters. It is probable that a scheme for training such students would form a useful addition to the present proposals. Should this view be accepted, no difficulty will be found in drawing up suitable courses.

A. W. CROFT.

10*th March* 1879

CHAPTER V.

ESTABISHMENT OF SEEBPORE COLLEGE.

Report of the Committee appointed under the Resolution of the Government of Bengal in the Public Works Department, No. 161E., dated 30th January 1878, to consider the question of the establishment of a Practical Training Institution for Engineers at Calcutta in connection with the Public Works Department workshops.

His Honour the Lieutenant-Governor of Bengal having thought it advisable to establish a Practical Training Institution for engineers in Calcutta, this Committee was appointed for the purpose of considering and reporting what measures it was desirable to take for the establishment of a Technical School, to be connected with the workshops and manufactories of the Public Works Department at the Presidency.

2. The Committee were also to consider "whether it would be desirable to remove the Civil Engineering Branch of the Presidency College to the neighbourhood of the Practical Training School, so as to work the two together as one institution for giving a complete technical education and training for engineers." It was also considered that "the necessity for constructing new workshops at the Presidency made it a convenient time to take up the subject with reference to their situation and size."

3. The question of the site for the proposed institution has been disposed of by the selection of the Bishop's College premises at Seebpore near Howrah

4 A large area of land has also been taken up on the river bank immediately above Bishop's College premises, and on this land the Public Works Department have commenced their new workshops, on a scale that will fully meet the requirements of an Engineering College and Technical School in its earlier stages, and which will admit of expansion hereafter to any extent that may be required.

5. The Committee think that the site is excellently adapted for the purposes of such an institution, and that the present buildings, with the new workshops, will suffice for its commencement. They are also unanimously of opinion that the Civil Engineering Branch of the Presidency College should be removed to the Bishop's College premises, and be incorporated with the proposed Engineering College

6. By the location of the educational branch of the institution in the Bishop's College premises, and by the establishment of the new Public Works Department workshops, which will serve as the practical training branch of the institution, in the land close by, these two branches (which will, however, be separate, and under entirely independent management) can be made to form one great Technical School for the training of engineers and mechanics.

7. In coming to a conclusion as to the organization of the proposed institution, the Committee have been greatly assisted by a valuable note drawn up by Mr. Croft. They think that the institution should be organized at first with the view of training four classes of pupils, as follow:—

(1)—Civil engineers.	(3)—Civil overseers.
(2)—Mechanical engineers.	(4)—Mechanical overseers.

A fifth class for draftsmen, and a sixth for the improvement of skilled workmen, corresponding to the mistri class at Roorkee and to Colonel Hyde's class at the Mint, might also be usefully established

8. Pupils for the first two classes should be admitted up to the age of 19, on producing a certificate of having passed the University Entrance examination The course should extend over a period of five years, the first four of which should be given to theory and practice, and the fifth to practice only.

9. The course for civil engineers (class 1) need not differ widely from that now prescribed for students of the Civil Engineering College; but it should be modified, where necessary, in order to bring it fully up to the standard of the Royal Civil Engineering College at Cooper's Hill. Subject to future modification, the Committee think it might stand as follows:—

COURSE FOR CIVIL ENGINEERS.

I.—Pure Mathematics.

Arithmetic and algebra.	Trigonometry, logarithms, and mensuration.
Plane geometry and conic sections.	Differential and integral calculus.
Practical or descriptive geometry.	

II.—Applied Mathematics.

Energy and work.	Hydrostatics and hydrodynamics.
Statics and dynamics.	Optics.

III.—Physics.

General physics.	Physical geography, mineralogy, and geology.
Chemistry and heat.	

Telegraphy.

IV.—Drawing.

Isometrical, orthographic, and perspective. | Mechanical drawing. Plans and surveys.

Free-hand drawing.

V.— Architecture.

History of architecture. | Study of styles and models.

Acoustics.

VI.—Surveying and Engineering.

Estimating. | Hydraulic works.
Construction. | Carpentry and mechanism.
Earthwork, roads, and railways. | Strength of materials.

Surveying and geodesy.

10. This theoretical course should be got over in four years. The practical work during these years would consist of three hours daily training in the carpenters and pattern shop, the smithy, the foundry, and the fitting shop, in which the pupils should go through the full Whitworth course. Thus in the carpenter's shop they would learn how to set and use the axe, saw and plane, hammer and chisel, and to execute all the different joints used by carpenters and joiners; they should also learn the use of the various machine tools employed in the conversion of wood. In the smithy they should be taught forging, welding, the use of the file, and making simple tools. In the foundry they should learn the method of making patterns, moulding, and casting. In the fitting shop they should learn the use of the simple tools commonly employed, as well as of machine tools, and the method of fitting together the parts of machinery, steam-engines, &c.

11. In the cold seasons of the second, third, and fourth years the students should go on survey parties, as the students of the Civil Engineering College do at present. The last year should be spent partly at Akra to learn brick-making, and partly on works in actual course of construction, in which a certain amount of work and responsibility of various kinds should be given to the pupils, and on which they would have an opportunity of learning masonry, brick-laying, &c., as well as the management of work-people and the keeping of accounts.

12. During the fourth year the practice of the Central School in Paris might occasionally be followed, where the pupils receive every month a short specification of a certain work to be designed. The designs, specifications, and estimates should be ready by the following month. The pupil can consult any authorities he pleases, but he is bound to produce an original design, making his drawings in the class-room. After the design is complete, the Professor cross-examines every pupil as to his reason for choosing the dimensions, materials, and form adopted, and finally criticises and corrects the design.

13. The course for mechanical engineers (class 2) may be as follows:—

COURSE FOR MECHANICAL ENGINEERS.

I.—Pure Mathematics

Arithmetic and algebra. | Trigonometry, logarithms and mensuration.
Plane geometry and conic sections. | Differential and integral calculus.
Practical or descriptive geometry.

II.—Applied Mathematics.

Statics and dynamics. | Energy and work.
Kinematics. | Hydrostatics and hydrodynamics.

III.—Physics.

Chemistry and heat. | Mineralogy.
Electricity and magnetism. | Telegraphy.

IV.—Drawing.

Free-hand drawing. | Architectural drawing.
Mechanical ditto. | Geometrical projections.

V.—Mechanism.

Mechanical technology. | History of inventions.

VI.—Machines and Engineering.

Prime-movers and steam-engines. | Strength of materials.
Hydraulic machinery. | Metallurgy.

Designs of factories.

14. The pupils should go through the same preliminary course of practical training as the Civil Engineers, working three hours a day in the workshops; but in the latter years of the course their attention should be particularly directed to the working up of iron and steel, and to the use of all forms of hand and engines tools employed in the making of machinery. If time could be spared, it would be very desirable that, during one cold season, they should work with the Civil Engineering students on a survey party.

15. They should, during their course, be frequently exercised in designs of machines and the preparation of complete drawings, specifications, and estimates. If possible, they should, during the fifth year be deputed to some large engineering work in progress, on which they might have some definite occupation and responsibility. If no such opportunity offered itself, they would spend their fifth year also at the institution, and would be employed in supervising actual work in the shop.

16. Students in the civil and mechanical engineering classes should present themselves for the corresponding examinations of the University at the end of their fourth year; but no candidate, after passing this examination, should be admitted to a degree unless at the end of the fifth year he can produce a certificate from the Principal of the institution stating that he has completed the full course of practical training. This certificate would be given by the Principal upon the report made by the Superintendent of the workshops, and by any other Executive Engineer under whom the student has been placed, as to his practical attainments. It must be observed, however, that as the courses of study and the procedure recommended above differ in many respects from those now in force, it will be necessary to ask the Senate of the University to modify their regulations accordingly.

17. Civil overseers (class 3) will consist of young men seeking to qualify themselves for the upper subordinate establishment of the Public Works Department and analogous positions; and mechanical overseers (class 4) of those desirous of being trained as skilled mechanics to take charge of engines and machinery in manufactories, on board steamers, on railways, or elsewhere.

18. The term of years for the full course should be for these lower classes the same as for the higher classes, viz, five years; but the theoretical standard will not be so high, and the period of practical training should be extended from a year to a year and a half. For both these classes there should be a qualifying examination in English, a vernacular language (colloquially), arithmetic, algebra to simple equations, and two books of Euclid. Any candidate who has passed the University Entrance examination in the subjects of English and mathematics should be admitted without further test

19. In the civil overseer classes candidates should be admitted between the ages of 15 and 17 years. But little change need be made in the present standard for overseers, and the educational course might be as follows:—

I.—Mathematics.

Arithmetic and algebra.	Trigonometry and mensuration.
Modern geometry.	Statics and dynamics.

II.—Physics.

Elementary chemistry.

III.—Drawing.

Orthographic projections.	Architectural drawing.
Scales and figures.	Topographical ditto.

IV.—Surveying.

Theodolite.	Compass and plane table.
Box-sextant.	Levelling.

V.—Engineering

Estimating and designing.	Strength of materials.
	Construction.

20. This course should take about three and a half years, during which the students should spend four hours daily in the workshop The practical training for civil overseers should be similar to that proposed for Civil Engineers, but the overseers should be sent to Akra in the fourth year, and the whole of the fifth year should be spent on works in progress.

21. With regard to mechanical overseers (class 4), it is to be observed that the Board of Trade regulations require that every person who is employed as an engineer on a steamer shall have served a full term of apprenticeship to his trade. On these and other grounds it is necessary to provide that the students in the mechanical overseer class should be apprenticed to the Superintendent of workshops. They will therefore be subject to all the legal conditions relating to apprentices; and it is accordingly desirable that students of this class, who will be bound for five years, should not be generally admitted after the age of 16. It might, however, be understood that the restriction as to age, in this as well as in the previous cases, might be relaxed on sufficient cause being shown.

22. The course of study for mechanical overseers should be as follows:—

I.—Mathematics.

Arithmetic and algebra	Plane trigonometry and mensuration.
Modern geometry.	Statics, dynamics, and hydrostatics.

II.—Natural Science.

Chemistry.	Experimental physics.
Physical geography.	Metallurgy.

III.—Drawing.

Orthographic projections.	Drawing of machinery from models and actual machines.
Practical geometry.	
Free-hand drawing.	

IV.—Mechanical Engineering.

Estimating.	Strength of materials.
Applied mechanics.	Mechanism.

The steam-engine.

23. This theoretical course should be completed in three and a half years, and during this period the pupils should spend four hours daily in the workshops The last year and a half of their apprenticeship should be spent entirely in the workshops.

24. The departmental examinations of civil and mechanical overseers should be held at the end of their theoretical course; but the final certificate, which should be given by the Principal of the college and the Superintendent of the workshops jointly, should be withheld until the satisfactory completion of the practical course.

25. A class should also be formed in the educational branch of the institution for the training of a superior set of skilled draftsmen and estimators (class 5); and no draftsman should receive a certificate unless he has shown himself qualified to take out detailed quantities and prepare estimates from designs. This class would not require any workshop training.

26. In the mistri class (class 6), instruction in rough mechanical drawing and the use of scales, together with arithmetic, elementary geometry, and the mechanical powers, should be given free of charge to apprentices, artizans, and mechanics, whether European, East Indian, or Native, and whether employed in the shops or outside. This class should preferably be held in the evening.

27. The proposed college should be conducted as other Government colleges are, on the principle of fee-payments for tuition. In the Civil Engineering Department of the Presidency College the fee at present is Rs. 5 per mensem for all classes of students—for those who qualify themselves by a single year's course for the grade of sub-overseer, as well as for those who complete the full course for engineers, and present themselves for examination by the University. As these classes of students will now be entirely separated, the Committee recommend that a difference should be made in the rates of fees, corresponding to the differences in the preliminary standard of instruction, in the course of study pursued, and in the future careers open respectively to students of the two classes. They are of opinion that for engineering students, civil and mechanical, a fee of Rs. 10 or Rs. 12 a month (as in the General Department of the Presidency College) would be by no means out of proportion to the cost of the education of these classes; but with the object of making the institution as attractive as possible at the outset, they recommend that a fee of Rs. 8 a month be charges to engineering students during the four years of their instruction in class. Existing student of the Civil Engineering Department of the Presidency College, who might elect one of the engineering courses in the new institution, should be allowed to continue their studies of payment of the present rate of Rs. 5 a month. No fee should be charged to any studend after the close of his theoretical course.

28. For civil overseers a monthly fee of Rs 3 should be charged during the three and a half years of their instruction in class, and for the draftsman class the same rate of fee. The mistri class, as before stated, will pay no fees. With regard to students of the mechanical overseer class, who will be apprenticed, different considerations arise. The usual practice as regards apprentices is that they pay at the outset an apprenticeship fee for instruction and maintenance, and after the end of their first year of service, receive payment at a yearly increasing rate in consideration of the value of their work to their master. This method can be modified in any way that may be desirable; and there is no doubt that the system of monthly payments would be much more convenient to the student-apprentices than that of an initial apprentice fee. Estimating the cost of instruction (as in the case of civil overseers) at Rs. 3 a month, and the cost of maintenance of native students at Rs. 8 a month, a monthly payment of Rs. 11 would appear to be, in the case of mechanical overseers, the proper substitute for an apprentice fee. But as a set-off there must be considered—*firstly*, the value of the apprentice's labour; *secondly*, the reluctance which it is believed that many natives feel towards binding themselves as apprentices; and *thirdly*, the interest which the State has in creating this class of skilled mechanics. On the whole it appears to the Committee that a monthly payment of Rs. 3 (exactly as in the civil overseer class, though arrived at in a different way) would meet the case of native students in the mechanical overseer class. It is noted that native apprentices at Dehree are educated for nothing, and are charged only one rupee out of eight for their board. This appears to be too low a rate. Civil overseers and mechanical overseers will belong to the same class of society; and it is probable that a parent

would be at least as willing to pay Rs. 3 for the education and maintenance of his son as an apprentice, as to pay the same sum for his bare education as an independent student. It is also believed that the reluctance which Bengali students have shown to entering the Dehree School will have much less weight as regards an institution in the immediate neighbourhood of Calcutta.

29. For European and Eurasian apprentices in the mechanical overseer class, a similar reduction should be made The cost of maintenance in their case is not less than Rs. 15 a month, and that of instruction and maintenance together Rs 18. If therefore in the case of native apprentices a monthly rate of Rs 3 be charged out of a total expenditure of Rs 11, the rate for European or Eurasian apprentices should be fixed at Rs. 5, which is the existing rate at Dehree

30 The Committee understand that there is every probability that the Dehree workshops will be closed as a Practical Training School, and that the apprentices now there will be transferred to Calcutta. If this transfer be effected, it is presumed that the apprentices now at Dehree will continue to enjoy the advantages guaranteed to them on entering the school, and consequently that the higher rate of payment here proposed for native students will be levied only from new apprentices.

31. In order to increase the attractions of the institution at the outset, the Committee think that liberal expenditure should be incurred in scholarships There are at present ten scholarships of Rs. 20 a month, 50 of Rs 15 a month, and 100 of Rs. 10 a month, open to students in Bengal who pass the Entrance examination of the University. Some of these would no doubt be held by students joining the engineer classes of the proposed college, but the Committee think that an addition of one scholarship of Rs. 20, three of Rs. 15, and six of Rs. 10, tenable only in that institution, might be sanctioned for the engineer classes.

32. These special scholarships should be given annually, and should be tenable for two years. At the end of the second year, scholarships of the same number and value should again be competed for by the students of two years' standing, and should then be re-awarded to such of them as has made the greatest progress both in the class and in the shops. The Committee think that such a redistribution of scholarships would have a good effect in stimulating all students to industry.

33 At the end of the fourth year the University examination of engineer students will be held, as before explained. At present five stipends of Rs. 50 a month, tenable for two years, are given every year to the best five students of the Civil Engineering College who pass the final examination. These are equivalent to 10 stipends of the same amount, tenable for one year, or to four stipends of Rs 50 and ten of Rs 30, also tenable for one year; and the Committee think that these 10 or 14 stipends might be granted to those engineer students at the new institution who pass the best examination at the end of the fourth year. As the students during their last year will be employed under the Public Works Department, it is recommended that that department should bear the cost of these final stipends.

34. As regards scholarships for the overseer classes, the Committee think that ten scholarships of Rs. 7 a month, tenable for three and a half years, and subject to diligence in the school and the workshops and to good conduct, should be granted annually in the new enstitution to civil overseers. In order still further to stimulate civil overseer students to exertion, it will be advisable to give, at the final examination at the end of the three and a half years' course, ten stipends of Rs 20 a month, tenable for one and a half years, or, alternatively, four stipends of Rs. 20 a month, and ten of Rs 12, tenable for the same period. These stipends will enable the successful students to support themselves while at Akra, or when deputed to works in progress of construction As, after a combined theoretical and practical course of three and a half years, the overseer students ought to be able to render fair service, these five stipends should, as in the former case, be paid by the Public Works Department, and could be charged against the works on which the students are actually employed. In the case both of engineers and overseers, it might be provided that the number of scholarships awarded at any one time should not exceed one-half the number of candidates presenting themselves for examination This restriction should not, however, apply to the case of stipends, which might be awarded up to the number sanctioned, on the recommendation of the Principal, to any candidate who succeeded in passing the final examination.

35. To mechanical overseers, as apprentices, the system of scholarships will not be applicable. But as an encouragement and stimulus to good work, an equivalent to that system might well be introduced This should consist in admitting those of the apprentices, who made the best progress both in class and in the shop, to a share in the value of the work done by him. Since the maintenance of the apprentices is undertaken by Government, scholarships are not necessary; but a system of rewards, even of small value, for good work would have precisely the same effect in encouraging apprentices to industry and good behaviour, and would be much more in conformity with their actual position. The rate of reward might be determined hereafter, and apprentices should only be admitted to this privilege after the expiration of one year of their time.

36. The Committee are of opinion that the system of boarding, which is obligatory in the case of apprentices, should be extended so as to include students of all the other classes who might wish to take advantage of it. It is believed that the Bishop's College building contains ample room for this purpose, after every necessary provision has been made for class-rooms and other similar accommodation. Any boarding-house that may thus be established for students of the institution, other than apprentices, should be conducted on the principle of paying its own expenses, rent only excepted. Separate accommodation

should be provided for European and for native students; and further, for Europeans of the Engineer classes, a better standard of living and a higher rate of payment would be necessary than for Europeans in the overseer class, who will be lower in the social scale. It is probable that a boarding charge of Rs. 20 a month in the case of the former, and of Rs. 15 in that of the latter, will be sufficient. For native boarders a uniform charge of Rs. 8 a month might be fixed. The supervision and discipline of all the boarders should be entrusted to the Superintendent of the Workshops, since that officer will be in direct charge of the class of apprentices. It may hereafter be necessary, should the number of European and Eurasian boarders be large, to appoint a European steward to assist the Superintendent.

37. Other questions relating to discipline, and depending on the subordination of the pupils to two independent officers, namely, the Principal of the institution and the Superintendent of the workshops, might be settled in detail hereafter. It appears to the Committee that no difficulty need arise on this account. The apprentices will be in much closer subordination to the Superintendent of the workshops than the other classes of students will be. All boarding pupils should be, as before stated, under the control of the same officer out of class hours. During the hours of instruction, whether in class or in the shop, the Principal should have the final control of the students; all instances of misbehaviour in the workshop being reported by the Superintendent to that officer. In the case of apprentices, however, the procedure would be reversed, and the Principal would report acts of disobedience in the class-room to the Superintendent for punishment.

38. The instructive staff required for the new institution would be the following:— A senior and junior Professor of Engineering, a Professor and a Lecturer in Mathematics, a Professor of Physical Science, and a Teacher of Drawing. One of these officers should be the Principal of the institution. The first four could be transferred from the Civil Engineering Department of the Presidency College, which would now cease to exist, and it would be necessary to procure a Professor of Physical Science, a graded officer, from England. It is understood that the present Teacher of Drawing in the Civil Engineering Department is about to retire from the service, and his successor should possess the qualifications required in the new institution, which include a knowledge of architecture and ability to teach free-hand drawing. An officer on smaller pay will be required to assist in the instruction of the overseer, mistri, and estimator classes. For these and other duties Mr Gilmore, the present Head Master of the Dehree School, is believed to be well qualified.

39. The following is a general estimate of the educational expenditure involved in the foregoing proposals:—

Head of Charge.	Present sanctioned expenditure.	Proposed expenditure.	Remarks.
I.—Education Department.	Rs.	Rs.	
3 graded Professors	26,700	26,700	As in the budget for 1879-80.
1 „ Professor of Physical Science ...	.....	12,000	
1 Teacher of Drawing	5,400	5,400	
1 Lecturer in Mathematics	1,500	1,500	
1 Assistant teacher	.....	3,000	Transferred from Public Works Department.
Clerks and servants	480	1,080	Addition of Rs. 600 for head clerk, who will also be Superintendent of native boarders, with total pay of Rs. 100 a month.
Survey allowance (including wages of chainmen)	2,000	2,000	
Model allowance	600	600	
Library	.....	600	
Miscellaneous	1,000	2,000	Addition for chemical and other contingencies.
Total ..	37,680	54,880	
Scholarships. Rs.			
Engineer—			
1 at Rs. 20 240			
3 „ 15 540			
6 „ 10 720			
Total 1,500	.....	6,000	The full charge would be incurred in the fourth year.
Overseer—			
10 at Rs. 7 840	.....	2,940	Tenable for three and a half years.
Total ...	37,680	63,820	

The charge for scholarships would be Rs. 2,340 in the first year, Rs. 4,680 in the second, Rs. 7,020 in the third, and Rs. 8,940 in the fourth. Also in each of the first and second years an expenditure of Rs. 5,000 would be necessary for fitting up a laboratory, and for procuring models, apparatus, and the foundation of a library. Further, the allotment on account of the present graduate scholarships (Rs. 6,000) would be, in accordance with the foregoing proposals, transferred from Education to Public Works. Hence the effect upon educational expenditure in the first four years would be as follows:—

	Present expenditure.	Proposed expenditure.	Increase
	Rs.	Rs.	Rs.
1st year	43,680	62,220	18,540
2nd „	43,680	64,560	20,880
3rd „	43,680	61,900	18,220
4th „	43,680	63,820	20,140

40. The receipts will of course vary with the number of pupils. The following may be assumed as a probable estimate of the numbers in each class and of the corresponding fee-receipts. Of the total amount of Rs. 3 and Rs. 5 to be paid by European and Native mechanical apprentices, respectively, for education and maintenance, it is assumed that one rupee is paid for instruction and the rest for maintenance:—

Class.	Number.	Monthly fee.	Total annual receipts.
		Rs.	Rs.
1. Civil engineers	30	8	2,880
2. Mechanical engineers	30	8	2,880
3. Civil overseers	60	3	2,160
4. Mechanical overseers	60	1	720
5 Draftsmen	30	3	1,080
Total ...	210	.....	9,720

The present number of pupils in the Civil Engineering College is 90, and there are over 50 apprentices at Dehree. The fee-receipts at the Civil Engineering College amount to about Rs. 6,000 a year. Increased fee-receipts would therefore reduce the additional cost of the new institution to Government by Rs. 3,720. Again, the Dacca Artizan School might be closed on the opening of the proposed college, and a further yearly saving of Rs. 3,176 effected. Hence the net increase of educational expenditure would vary from Rs. 11,644 in the first year to Rs. 13,244 in the fourth.

41. In considering the expenditure to be incurred in the Public Works Department, the Committee have not thought it within their province to investigate the probable outlay involved in the first establishment of the proposed workshops Once established, these workshops will be self-supporting. The Public Works officers in charge will continue to be paid

as heretofore in their own department; and the cost of all the other establishment and contingencies will be charged, as at present, direct to manufacture. But as regards the proposed training school, the following expenditure seems to be involved :—

II.—Public Works Department.

Head of Charge.	Proposed expenditure.	Remarks.
Supervision and Instruction.	Rs.	
Allowance to Superintendent at Rs. 150 a month	1,800	As at present sanctioned.
Fees to four foremen at Rs. 50 a month ...	2,400	Ditto ditto.
Allowance to monitors at Rs. 24 a month* ...	288	Ditto ditto.
Stipends and Rewards.		
Engineer stipends—		
10 at Rs 50 for one year	6,000	Transferred from Education Department.
Overseer stipends—		
10 at Rs 20 for one and a half years ...	3,600	
Rewards to apprentices	600	One-fifth of the estimated value of their work.
Boarding Charges.		
30 European apprentices at Rs. 11 a month ...	3,960	Rs. 4 out of Rs. 15 paid by the pupil.
40 Native „ „ 6 „ ..	2,880	„ 2 „ „ 8 ditto.
Native Superintendent of boarders	600	Half of this officer's pay charged to Education Department as head clerk.
Servants and contingencies	2,000	
Total ...	24,128	

	Rs.
1 Monitor of discipline	4
4 Monitors of bungalows at Rs. 3 a month ...	12
4 „ of workshops at Rs. 2 a month ...	8
Total	24

The cost of the Dehree School, amounting to Rs 18,000 a year, would however be saved, and the net increase in this department would amount to Rs. 6,128 a year.

42. The total additional cost of the institution would therefore vary, according to the foregoing estimates, from Rs. 17,772 in the first year to Rs. 19,372 in the fourth and subsequent years. It will of course be observed that any increase in the mechanical apprentice class, the numbers of which might however be limited, would cause an increase in the total expenditure; while an increase in the numbers of the other classes would involve increased fee-receipts, and a corresponding reduction in the cost of the institution to Government.

43. In the foregoing proposals the question of engaging and training lads as ordinary apprentices to particular trades has not been considered. It is very desirable that a supply of skilled mechanics—blacksmiths, founders, fitters, joiners, and the like—should be turned out by the Government workshops in the ordinary course of their operations; and that result can only be secured by the introduction of a system of apprenticeship. But this question has little or no relation to the subject of technical education, and it can be taken up by the Public Works Department quite independently of the proposals made in this report. It only remains to be added that, for apprentices in the shops, as for other workmen, the mistri class, recommended in paragraph 26 above, would provide the necessary general and technical education.

A. CADELL ... *President.*

A. MACKENZIE,
A. W. CROFT,
H. C. LEVINGE,
T. S. ISAAC. } *Members.*

Note by SIR A. EDEN *on the Committee's Report as to the establishment of a Practical Training Institution at Calcutta.*

THIS report has reached me so late, the very day before I leave, that I am unable to deal with it as I should have wished, especially as I have by me only the report and not the previous papers. I must content myself by a brief note of my views on the points raised by the Committee, and must ask Sir Steuart Bayley to be good enough to push the work on.

I must first explain how the matter now stands. We have for some time past had our Public Works workshops near Prinsep's Ghât In this we have, with very insufficient machinery, turned out a very large amount of work. I cannot, without the papers, give the exact figures, but I think that over two lakhs of rupees worth of work for the department has been executed there during the past year. We have there, on a small scale, tried the experiment of giving technical instruction to the young men who have passed the civil engineering course, and we have been able to establish the fact that young natives of the middle class and of good caste, will, without hesitation, work with their own hands willingly in the forge, the carpenter's shops, and the brick-field.

I have agreed with the S. P. G. for the purchase of Bishop's College, and when the Government of India insisted upon the removal of the Public Works shops from the Hastings' premises, I at once had the new shops constructed on the premises adjoining Bishop's College. The conditions of the transfer involved the purchase of a site for the new Bishop's College in the neighbourhood of the Cathedral. There has been much trouble and delay about this; but the arrangements, which are in Mr. Heysham's hands, are now nearly completed. I understand that, as soon as this is done, the Bishop will not object to remove the few lads now at Bishop's College into a hired building while the new college is under construction. I may add that I believe that it is the intention of Maharajah Jotendro Mohun Tagore, with characteristic liberality, to build a special college residence on the Bishop's College premises, for the reception of young boys from the mofussil who come up to join the Engineering College.

The Dehree workshops must be closed, as there is little further work for them to do; and that school must now be amalgamated with the new school, the machinery being brought down to the new workshops.

I agree in all the recommendations of the Committee, but I think that a strict limit must be put upon the number of apprentices for the present. There should be 30 Europeans and Eurasians, and 40 native apprentices. I think that 30 native apprentices to 30 Europeans is hardly a fair proportion, and if there were room for them, I would prefer to see even 50 native apprentices admitted. This would only make their cost Rs. 3,600 against Rs. 3,960 to be expended for Europeans. I am not quite sure whether the European and Eurasian boys should not pay Rs. 5 instead of Rs. 4. No doubt many would be sent there by charitable associations and societies

The present Dehree boys must continue on the terms on which they were originally received.

I have no doubt that many wealthy native gentlemen residing in the country will gladly avail themselves of the opportunity now afforded them of sending up boys either as apprentices or as students on scholarships When applications are made for apprentices to be received in excess of the 30 Europeans and 40 natives, this might be done on payment of the full fee of Rs. 15 for Europeans and Eurasians and Rs. 8 for natives.

We must be careful that it shall be understood that we do not guarantee appointments in the public service to any of the lads trained in the school. All we can do is to refuse to take any young men into the department in this country who have not been trained in this college; and for our purposes we should of course select the most distinguished students and most capable apprentices.

I think that I should be disposed to attach more importance to the establishment of a small vernacular class for boys, the sons of artizans and mistries, who should work regularly in the shops and have a few hours only of school training in the vernacular. A most successful school of this sort has been established and worked at Dehree.

These boys would not, of course, be boarders.

I attach the greatest importance to the scheme. I believe that it will do more good to the people of the country than any school yet established It will give native boys of all classes the means of obtaining a thoroughly practical education, which will enable them to leave the beaten track of clerical and ministerial service, for which alone they now care to qualify themselves. It will open to them a large and useful professional career, and will at the same time open out a career to the East Indian and European boys of the large cities.

I think that possibly some of the apprentices, for six months of the course, might be placed under the locomotive department of the State Railways, and qualify for engine-drivers. With this school properly worked, we ought never to have to import subordinates for the Public Works Department or mechanical engineers of the lower grades.

CHAPTER VI.

THE ESTABISHMENT OF SEEBPORE COLLEGE.

No. 2310E.

Extract from the Proceedings of the Hon'ble the Lieutenant-Governor of Bengal in the Public Works Department (Establishments), under date the 15th December 1879.

READ—

The report of the Committee appointed to consider the question of the establishment of an educational and Practical Training Institution for Engineers at the Presidency in connection with the Public Works Department workshops.

Read again—

Proceeding of this Department for January 1878 (Establishments), No. 1A., being a Resolution by the Lieutenant-Governor in this Department, appointing a Committee to consider and report on the measures necessary to establish the Practical Training School for Engineers at the Presidency.

RESOLUTION.—The establishment of a practical training institution in Calcutta for civil and mechanical engineers has for some time been under the consideration of this Government An experiment has already been made in this direction by allowing passed students of the Civil Engineering classes of the Presidency College to join the workshops of the First Calcutta Division and the Akra Brick Manufactory for a two years' course of technical instruction; and the result has shown that there is a demand for such instruction, and that native youths of the middle class and of high caste will, without hesitation, work willingly with their own hands at the forge and at the lathe, in the carpenter's shop and in the brickfield, exactly as European apprentices would do.

2. This fact having been established, a Committee was appointed in January 1878 to consider and report what measures it was necessary or desirable to take for the establishment of a technical school to be connected with the workshops and manufactories of the Public Works Department at the Presidency. The Committee was further to consider whether it would not be desirable to remove the Civil Engineering Branch of the Presidency College to the neighbourhood of the new institution, so that the two might be worked together, and theoretical instruction be combined with thorough practical technical training; and it was added that the necessity for constructing new workshops at the Presidency made it a convenient time for taking up the whole question, and for considering the best situation for the new institution, and the nature and extent of the buildings required.

3. The Committee unanimously recommend that the Civil Engineering Branch of the Presidency College should be incorporated with the proposed institution, the whole forming one great Technical School for the training of engineers and mechanics, but that the theoretical and practical branches should be under entirely independent management, the supervision and control of the former resting with the Educational Department, and that of the latter with the Public Works Department

4. Meanwhile the question of site was disposed of by the selection of premises at Seebpore near Howrah, and by the acquisition of a large area of land on the river bank immediately above those premises

5. Arrangements are in progress for the purchase of these premises, which are suited for a college, and already workshops have been constructed on the land adjoining on a scale that will in the opinion of the Committee, fully meet the requirements of an engineering college and technical school in its earlier stages, and will admit of expansion hereafter to any extent that may be required.

6. In regard to the organization of the proposed institution, the Committee recommend that, at first, the following four classes of pupils should be trained:—

(1) Civil Engineers.	(3) Civil Overseers.
(2) Mechanical Engineers.	(4) Mechanical Overseers.

and that a fifth class for draftsmen and a sixth for the improvement of skilled workmen, corresponding to the mistri class at Roorkee and to Colonel Hyde's class at the Mint, might be usefully established. That pupils for the two higher classes should be admitted up to the age of 19 on producing a certificate of having passed the University Entrance examination; that for the third class they should enter between the ages of 15 and 17, and for the fourth class up to 16, but that the restriction as to age should be relaxed on sufficient cause being shown.

7. The course for Civil and Mechanical Engineers should, in the Committee's opinion, be as follows:—

COURSE FOR CIVIL ENGINEERS.

I.—Pure Mathematics.

Arithmetic and algebra.	Trigonometry, logarithms, and mensuration.
Plane geometry and conic sections.	Differential and integral calculus.
Practical or descriptive geometry.	

II.—Applied Mathematics.

Energy and work.	Hydrostatics and hydrodynamics.
Statics and dynamics.	Optics.

III.—Physics.

General physics.	Physical geography, mineralogy, and geology.
Chemistry and heat.	Telegraphy.

IV.—Drawing.

Isometrical, orthographic, and perspective.	Plans and surveys.
Mechanical drawing.	Free-hand drawing.

V.—Architecture.

History of architecture.	Study of styles and models.

Acoustics.

VI.—Surveying and Engineering.

Estimating.	Hydraulic works.
Construction.	Carpentry and mechanism.
Earthwork, roads, and railways.	Strength of materials.

Surveying and geodesy.

This theoretical course should be got over in four years. The practical work during these years would consist of three hours daily training in the carpenters and pattern shop, the smithy, the foundry and the fitting shop, in which the pupils should go through the full Whitworth course. Thus in the carpenter's shop they would learn how to set and use the axe, saw and plane, hammer and chisel, and to execute all the different joints used by carpenters and joiners; they should als learn the use of the various machine tools employed in the conversion of wood. In the smithy they should be taught forging, welding, the use of the file, and making simple tools. In the foundry they should learn the method of making patterns, moulding, and casting. In the fitting shop they should learn the use of the simple tools commonly employed, as well as of machine tools, and the method of fitting together the parts of machinery, steam-engines, &c.

In the cold seasons of the second, third, and fourth years the students should go on survey parties, as the students of the Civil Engineering College do at present. The last year should be spent partly at Akra to learn brick-making, and partly on works in actual course of construction, in which a certain amount of work and responsibility of various kinds should be given to the pupils, and on which they would have an opportunity of learning masonry, brick-laying, &c., as well as the management of work-people and the keeping of accounts.

COURSE FOR MECHANICAL ENGINEERS.

I.—Pure Mathematics.

Arithmetic and algebra.	Trigonometry, logarithms, and mensuration.
Plane geometry and conic sections.	Differential and integral calculus.
Practical or descriptive geometry.	

II.—Applied Mathematics.

Statics and dynamics.	Energy and work.
Kinematics.	Hydrostatics and hydrodynamics.

III.—Physics.

Chemistry and heat.	Mineralogy.
Electricity and magnetism.	Telegraphy.

IV.—Drawing.

Free-hand drawing.	Architectural drawing.
Mechanical ditto	Geometrical projections.

V.—Mechanism.

Mechanical technology.	History of inventions

VI.—Machines and Engineering.

Prime-movers and steam-engines.	Strength of materials.
Hydraulic machinery.	Metallurgy.

Designs of factories.

The pupils should go through the same preliminary course of practical training as the civil engineers, working three hours a day in the workshops, but in the latter years of the course their attention should be particularly directed to the working up of iron and steel, and to the use of all forms of hand and engine tools employed in the making of machinery. If time could be spared, it would be very desirable that during one cold season, they should work with the civil engineering students on a survey party.

They should, during their course, be frequently exercised in design of machines and the preparation of complete drawings, specifications, and estimates. If possible, they should during the fifth year be deputed to some large engineering work in progress, on which they might have some definite occupation and responsibility. If no such opportunity offered itself, they would spend their fifth year also at the institution, and would be employed in supervising actual work in the shop

8. The Committee further recommend that students in the civil and mechanical engineering classes should present themselves for the corresponding examinations of the University at the end of their fourth year, but no candidate after passing this examination should be admitted to a degree, unless at the end of the fifth year he can produce a certificate from the Principal of the institution stating that he has completed the full course of practical training. This certificate would be given by the Principal upon the report made by the Superintendent of the workshops, and by any other Executive Engineer under whom the student has been placed, as to his practical attainments It must be observed, however, that as the courses of study and the procedure recommended above differ in many respects from those now in force, it will be necessary to ask the Senate of the University to modify their regulations accordingly.

9. Civil overseers (class 3) will consist of young men seeking to qualify themselves for the upper subordinate establishment of the Public Works Department and analogous positions, and mechanical overseers (class 4) of those desirous of being trained as skilled mechanics to take charge of machinery in manufactories, and of marine and locomotive engines, &c, &c. The Committee recommend that the term of years for the full course should be for these lower classes the same as for the higher classes, viz., five years; but that the theoretical standard should not be so high, and that the period of practical training should be extended from a year to a year and a half. For both these classes there should be a qualifying Entrance examination in English, a vernacular language (colloquially), arithmetic, algebra to simple equations, and two books of Euclid. Any candidate who had passed the University Entrance examination in the subjects of English and mathematics should be admitted without further test.

10. The course for the lower classes will be as follows:—

CIVIL OVERSEERS.

I.—Mathematics.

Arithmetic and algebra. Modern geometry.	Trigonometry and mensuration. Statics and dynamics.

II.—Physics.

Elementary chemistry.

III.—Drawing.

Orthographic projections. Scales and figures.	Architectural drawing. Topographical ditto.

IV.—Surveying.

Theodolite. Box-sextant.	Compass and plane table. Levelling.

V.—Engineering.

Estimating and designing.	Strength of materials.
Construction.	

This course should take about three and a half years, during which the students should spend four hours daily in the workshop. The practical training for civil overseers should be similar to that proposed for civil engineers; but the overseers should be sent to Akra in the fourth year, and the whole of the fifth year should be spent on works in progress.

MECHANICAL OVERSEERS.

I.—Mathematics.

Arithmetic and algebra. Modern geometry.	Plane trigonometry and mensuration. Statics, dynamics, and hydrostatics.

II.—Natural Science.

Chemistry. Physical geography.	Experimental physics. Metallurgy.

III.—Drawing.

Orthographic projections. Practical geometry. Free-hand drawing.	Drawing of machinery from models and actual machines.

IV.—Mechanical Engineering.

Estimating. Applied mechanics.	Strength of materials. Mechanism.
The steam-engine.	

This theoretical course should be completed in three and a half years, and during this period the pupils should spend four hours daily in the workshops. The last year and a half of their apprenticeship should be spent entirely in the workshops.

11. The Committee also, with regard to mechanical overseers (class 4), draw attention to the fact that the Board of Trade regulations require that every person who is employed as an engineer on a steamer shall have served a full term of apprenticeship to his trade. On these and other grounds it is necessary to provide that the students in the mechanical overseer class should be apprenticed to the Superintendent of Workshops, and be subject to all the legal conditions relating to apprentices. The departmental examinations of civil and mechanical overseers should be held at the end of their theoretical course; but the final certificate, which should be given by the Principal of the college and the Superintendent of the workshops jointly, should be withheld until the satisfactory completion of the practical course.

12. The class of draftsmen (class 5) proposed by the Committee would be attached to the educational branch of the institution, and would provide for the training of a superior class of draftsmen and estimators; and no draftsman would receive a certificate until he had shown himself qualified, not only to prepare designs and detailed drawings, but also to take out the detailed quantities and to prepare estimates from them. This class would require no workshop training: it would probably be found desirable to train some draftsmen in the preparation of mechanical working drawings. In the mistri or artizan class (class 6), instruction in rough mechanical drawing and the use of scales, together with arithmetic, elementary geometry, and the mechanical powers would be given free of charge to apprentices, artizans, and mechanics, whether European, East Indian, or Native, and whether employed in the shops or outside

13. The Lieutenant-Governor approves of the recommendations of the Committee, but he would, in addition, form a small vernacular class for the sons of artizans and mistries: these boys would work regularly in the shops, and would have only a few hours' school training in the vernacular.

14. In regard to the charge for education at the institution, the Lieutenant-Governor has decided, after careful consideration, that the fee for the two higher engineering classes shall be Rs. 8 per mensem during the four years of their instruction in class; but that existing students of the Civil Engineering Department of the Presidency College, who may elect one of the engineering courses in the new institution, may be allowed to continue their studies on a payment of Rs 5 a month. For civil overseers the charge will be Rs. 3 per mensem during the three and a half years of their instruction in class, and for draftsmen the fee will be the same. No fee will be charged to any student after the completion of his theoretical course. The mechanical overseer class will consist exclusively of regular apprentices, who must be boarders; and the charge will be for Europeans and Eurasians up to 30 in number Rs 5 each per mensem, and for Natives up to 40 in number Rs. 3 per mensem; but apprentices may be received in excess of that number on payment, if Europeans or Eurasians, of the full fee of Rs. 15 per mensem, and if Natives of Rs. 8 per mensem. Existing Dehree students who join the institution will be allowed to continue on the terms on which they were originally received.

15 No charge will be made for instruction to skilled workmen in the mistri or artizan class, or to those boys who join the class for the sons of artizans.

16. The Lieutenant-Governor has decided that one scholarship of Rs. 20, three of Rs. 15, and six of Rs. 10, tenable for two years, shall be given annually to students entering the engineer classes of the institution; and that scholarships of the same number and value shall be again competed for at the end of the second year's course: provided that the number of scholarships awarded does not exceed one-half the number of candidates presenting themselves for examination. These scholarships will be given independently of the scholarships now open to those who pass the Entrance examination at the University. For the civil overseer classes ten scholarships of Rs. 7 per mensem, tenable for three and a half years, subject to diligence and good conduct, will also be granted annually: provided, as in the engineer classes, the number of scholarships awarded does not exceed one-half the number of candidates

17. In lieu of the five stipends of Rs. 50 a month, tenable for two years, which are at present given to the best five students of the Civil Engineering College who pass the final examination, either ten stipends of Rs. 50, or else four of Rs. 50 and ten of Rs. 30 each will be granted to those engineer students at the new institution who pass the best examination at the end of the fourth year. Similarly, at the end of the three and a half years' course of civil overseers, either ten stipends of Rs. 20, or else four of Rs. 20 and ten of Rs. 12, tenable for one and a half years, will be granted. These stipends will be paid by the Public Works Department, and be liable to forfeiture in case of misconduct.

18. To mechanical overseers, as apprentices, the system of scholarships will not be applicable. An equivalent for this will be provided by allowing those who make the best progress a share in the value of the work done by them after the expiration of the first year of their apprenticeship.

19. It will be obligatory in the case of apprentices (class 4) that they should board on the premises; and the boarding system will be extended as far as possible so as to include all other students who may desire to take advantage of it. Any boarding-house that may thus be established for other than apprentices will be conducted on the principle of paying its own expenses, rent only excepted. It is hoped that a boarding charge of Rs. 20 a month for Europeans and Eurasians in the engineer classes, and Rs. 15 in the overseer classes, and a uniform charge of Rs. 8 for the native boarders will be found sufficient.

20 It is believed that the buildings which it is intended to purchase will furnish considerable room for boarders after every necessary provision has been made for class-rooms and other similar accommodation. In addition to this, the Lieutenant-Governor believes that it is the intention of a native nobleman, with characteristic liberality, to build a special residence on the premises for the reception of lads from the mofussil who come to join the engineering classes.

21. The financial aspects of the scheme may thus be briefly summarized. In the Educational Department there will be an estimated excess outlay of Rs. 11,644 net in the first year, which will increase to Rs. 13,244 in the fourth year, when the charge will remain constant This sum has been arrived at after allowing for the fee-receipts from the new institution, amounting to Rs. 3,720, more than the fees at present received from the students in the Civil Engineering College, and to a saving of Rs. 3,176 by closing the Dacca Artizan School, which school will no longer be required on the opening of the proposed institution. In the Public Works Department there will be an excess expenditure of Rs. 6,128, after allowing for a saving of Rs. 18,000 by closing the Dehree School. The total additional cost of the institution is therefore estimated to amount to Rs. 17,772 in the first year, and to Rs. 19,372 in the fourth and subsequent years.

22. It must be clearly understood that the Lieutenant-Governor does not guarantee an appointment in the public service to any one trained in the institution; but he will select the most distinguished students and the most capable apprentices to fill such vacancies as may arise, and will not appoint men in this country to the Public Works Department, or to district appointments, who have not been trained in this school, as soon as qualified men are obtainable from this source.

23. The Lieutenant-Governor believes that this institution will do more good to the people of this country than any school which has yet been established. It will give native boys of all classes the means of obtaining a thoroughly practical education, and will enable them to leave the beaten track of clerical and ministerial service, for which alone they now care to qualify themselves; and will open to them a large and lucrative professional career At the same time it will provide a suitable and useful training to European and Eurasian boys in this country, and place them in a position to earn an honourable livelihood in a profession for which they are well adapted.

ORDER.—Ordered that a copy of this Resolution be forwarded to the Educational and Financial Departments of this Government for information, and with a view to carry out the arrangements now sanctioned as early as practicable in communication with this department.

Ordered that a copy of this Resolution be forwarded to the Irrigation Branch of this department for information, with regard to the transfer of the Dehree Training School to the above institution.

Ordered that a copy of this Resolution be forwarded to the Mint Master, Calcutta, for information.

Ordered also that a copy of this Resolution be published in the Supplement to the *Calcutta Gazette* for general information.

No. 565, dated Fort William, the 4th February 1880.

From—A. W. CROFT, ESQ., M.A., Director of Public Instruction, Bengal,
To—The Secretary to the Government of Bengal, General Department.

I HAVE the honour to acknowledge the receipt of your letter No 27, dated 24th ultimo, informing me that the arrangements for the new Engineering College are sufficiently forward, so far as the Public Works Department is concerned, to make it necessary to provide in the budget for the expenditure which the institution will entail, and enquiring whether I can make arrangements to start the school, if necessary, with effect from the 1st April next.

2 The 39th and 40th paragraphs of the Report of the Committee appointed under the Resolution of the Government of Bengal, in the Public Works Department, No. 161E., dated 30th January 1878, give full details of the additional expenditure which the new institution will involve, and of the anticipated receipts from pupils. I presume therefore that it is unnecessary for me to submit a separate supplementary estimate on this account. The Civil Engineering College graduate scholarships, involving a cost of Rs. 6,000 a year, have been included in the sanctioned estimates of the Education Department for 1880-81. They should now, in accordance with paragraph 17 of the Resolution of Government upon the report of the Committee, be transferred to the estimates of the Public Works Department for that year.

3. The Resolution to which reference has just been made accepts the estimates of the Committee with regard to the educational expenditure involved in the scheme. Those estimates include the cost of an additional Professor of Physical Science on a salary of Rs. 12,000 a year. This amount was provided for by the Committee, having regard to the possibility that an educational officer of the third class, now on the establishment, might be appointed to the Professorship of Physical Science, in which case it would be necessary to include his salary amongst the educational expenditure of the new college But the real bearing of the Committee's proposals was that an extra appointment in the fourth class of the superior graded service should be created, so that the actual additional expenditure on this account is reduced from Rs. 12,000 a year to the salary of an officer on Rs. 500 rising to Rs. 750. I therefore request that the sanction of the Secretary of State may be asked to the creation of an extra appointment in the fourth class of the Bengal Education Department in order to provide for the new Professorship of Physical Science.

4. The Professor, however, is required, and should be asked for at once; and therefore, in order to avoid the delay which may be involved if the question of his appointment is subordinated to a general consideration of the whole scheme, I venture to urge that the Secretary of State should be asked to send out a competent Professor at the earliest possible date to fill the vacancy which will be caused by the impending retirement of Mr. J. W. McCrindle, Principal of the Patna College. As soon as it is known that the Government of India have moved the Secretary of State to create two extra appointments in the fourth class—one for the present Professorship, and the other for the Principalship of the Rajshahye College, I propose to submit to Government a further requisition for two officers to be appointed from England.

5. The Professor now to be appointed for the new Engineering College should be, if possible, a gentleman who has passed with credit through the Royal School of Mines, and who has continued to work for some time at chemistry or physical science after obtaining the certificate of Associate, Royal School of Mines. At the School of Mines practical work is insisted on, and the students take up most or all of the subjects which are included in the new college course These subjects are the following:—Chemistry, physics, metallury, mineralogy, and geology; and the person appointed as Professor should be competent to give advanced instruction in them all. It should be added that the course is one of four years; that the students have no knowledge of any physical subject before admission; and that the other subjects of the course, besides physical science, are pure and applied mathematics, drawing, mechanism or architecture, and engineering.

6. I have further to request that the Secretary of State may be asked to appoint and send out at the earliest possible date a trained Teacher of Drawing. The subjects which this officer will be required to teach are—Isometrical, orthographic, and perspective drawing; plans and surveys; architectural drawing; drawing of machinery from models and machines; free-hand drawing. I understand, from enquiries which I have recently made in England, that the Science and Art Department at South Kensington, under Colonel Donnelly, R.E., teaches a course exactly answering to the requirements of the new college. If that resource failed, an advertisement by the Secretary of State in the *Engineer*, or some similar professional journal, would probably bring forward eligible candidates. The officer would be provided for in the appointment to be vacated by Mr. Colesworthy Grant, in the first class of the Subordinate Educational Service, on Rs 400 rising in five years to Rs. 500. If the Government consented further to give this officer free quarters in the new college, that would doubtless add to the attractiveness of the post.

7. The two new officers cannot reach Calcutta by the 1st April, but the college can be opened from that date, should it be thought necessary. I anticipate little difficulty in making temporary arrangements until their arrival, which might be expected about the beginning of the rains in June. As soon as the date of opening is fixed, it is desirable that a notice of the fact should be published in the *Gazette*, together with a statement of the conditions under which the special scholarships sanctioned in paragraph 16 of the Resolution will be awarded. For the engineer scholarships it appears to me that it will be sufficient to award them according to the marks obtained by the candidates at the Entrance examination, preference being given in case of equality to those who have passed best in English and mathematics. These particulars I can procure from the Registrar of the University. For the overseer scholarship it will be necessary to hold a special examination a fortnight before the opening of the college—applications to be sent to this office a week before the examination begins.

No. 58, dated Calcutta, the 10th February 1880.

From—The Secretary to the Government of Bengal, General Department,
To—The Director of Public Instruction.

WITH reference to your letter No. 565 of the 4th February 1880, I am directed to say that the Lieutenant-Governor approves of the new educational and practical training school being opened from the 1st April 1880, and I am to request that the necessary arrangements for doing this may be taken in hand.

2. I am also to request that you will draw up a draft notice on the subject for publication in the *Gazette*, and will forward it for the approval of Government.

3. I am to add that a further communication will be made to you on the proposal of a permanent increase to the sanctioned strength of the Department of Education.

No. 59½, dated Calcutta, the 10th February 1880.

Memo. by—H. H. RISLEY, Esq., Under-Secretary to the Government of Bengal, General Deparment.

COPY of this letter, and of the one to which it is a reply, forwarded to the Public Works Department, General Branch, for information.

REGULATIONS OF THE GOVERNMENT ENGINEERING COLLEGE, HOWRAH.

[*N.B—Every parent or guardian of a pupil will be supplied with a Copy of these Rules, and must accept them in writing before his son or ward can be admitted to the College.*]

1. The College will be under the general supervision of a Board of Visitors appointed by the Government.

2. The students admitted to the College are of the following classes:—

Engineer class (in two sections—A, Civil; B, Mechanical).
Overseer class (C).
Mechanical apprentice class (D)

For admission to the engineer class a student must have passed the Entrance examination of the University. For admission to the overseer or to the mechanical apprentice class he must pass an examination in subjects to be fixed from time to time by the Director of Public Instruction. These subjects now include English, arithmetic, elementary algebra, and two books of Euclid.

Except by special sanction of the Director, on the recommendation of the Principal of the College or the Superintendent of the Workshops, no student will be admitted to the College unless he has passed the examination prescribed for his class.

3. The session for all classes will commence about the middle of June in each year. There will be two vacations, of about a month each; one beginning about the 1st October, the other about the 15th May.

4. The course of study in the engineer class (A and B) will extend over five years, during the first four of which the instruction will be both theoretical and practical. The last year will be spent entirely in practical work, either in the workshops or in the field. The monthly fee will be Rs. 8, payable for the first four years. An admission fee of Rs. 10 will also be charged.

5. The course of study in the overseer class (C), and in the mechanical apprentice class (D), will extend over five years, during the first three and a half of which the instruction will be both theoretical and practical. The last year and a half will be spent entirely in practical work. The monthly fee in the overseer class will be Rs. 3, payable for three and a half years; and an admission fee of Rs. 5 will be charged.

6. Pupils in the mechanical apprentice class will be bound by indenture to the Superintendent of the Workshops to undergo a five years' course of training, qualifying them to become skilled mechanics. Apprentices will be received up to the number of 30 Europeans or Eurasians, and 40 natives. They will be fed and lodged on the premises, and the charge for board and tuition, in lieu of an apprenticeship fee, will be Rs. 5 a month for the former class and Rs. 3 for the latter. Apprentices will, however, be received in excess of the number above stated on payment of the full cost of their board (*see* Rules 22 and 24) without any charge for tuition or rent of quarters.

All apprentices will be on probation for six months from the date of admission.

7. One scholarship of the value of Rs 20 a month, three of Rs. 15 a month, and six of Rs. 10, tenable for two years, will be given annually to students entering the engineer classes of the College; and scholarships of the same number and value will again be competed for at the end of two years, but the number of scholarships awarded will in no case exceed one-

half of the number of candidates. These scholarships will be awarded by the Director of Public Instruction, according to the place taken by the candidates in the University examinations.

8. For the overseer class, ten scholarships of Rs. 7 per mensem, tenable for three and a half years, subject to the condition of diligence and good conduct, will be awarded annually; but the number of scholarships will not exceed one-half of the number of candidates. These scholarships will be awarded by the Director of Public Instruction on the results of the qualifying examination.

9. To apprentices in the mechanical class the system of scholarships will not be applicable. An equivalent for this will be provided by allowing those who make the best progress a share in the value of the work done by them after the expiration of their first year of apprenticeship No apprentice will be credited with earnings for any month in which his name has been placed on the defaulter's book.

10. An examination of students of the engineer class will be held at the expiration of their fourth year of study. Four stipends of Rs. 50 each, and ten of Rs. 30 each, tenable for one year, will be awarded to those students who pass the best examination. Similarly, at the end of their three and a half years' theoretical course, four stipends of Rs. 20 each and ten of Rs. 12 each, tenable for one year and a half, will be awarded to those students of the overseer class who pass the best examination. All these stipends will be liable to forfeiture in case of misconduct.

11. For those students of the engineer and overseer classes who may wish to reside on the College premises, quarters will be provided, as far as the accommodation will permit, at a rent, to European and Eurasian students, of Rs. 5 a month, and to native students of Re. 1 a month Each resident student must provide his own bedding and clothing, and will be allowed to bring one box only, not larger than 3 feet × 1½ feet × 1½ feet. No other furniture will be allowed except by special permission of the Superintendent.

12. Students will attend in the class rooms and at the shops in accordance with a time-table approved by the Director of Public Instruction. The hours of work will vary with different seasons of the year.

13. Subject to the general control of the Director of Public Instruction and to the orders of Government prescribing the courses of study, the Principal of the College will direct and be responsible for the education of all students admitted to the College. When in the class-room, all students will be under the orders of the Principal. The routine of work in the shops will be determined by the Superintendent, under whose orders all students will be while in the shops.

14. When out of the class-room and the workshops, all students residing on the College premises will be under the orders of the Superintendent.

15 Breaches of discipline committed in the class-room will be reported to the Principal, who, in the case of students of the engineer and overseer classes, will dispose of them according to the rules and practice of the Education Department. In the case of mechanical apprentices, the Principal will report them to the Superintendent, who will deal with them in accordance with standing orders.

16. Breaches of discipline committed out of the class room will be reported to the Superintendent, who, in the case of mechanical apprentices, will deal with them according to standing orders. In the case of engineer and overseer students, they will be reported to the Principal for disposal.

17. For mechanical apprentices, a defaulter's book will be kept. Every entry in this book will be signed by the Superintendent and the apprentice, and a copy transmitted monthly to the Superintending Engineer. The Superintendent has no power to cancel or alter an entry once made and signed.

18. Apprentices are liable to have their names placed on the defaulter's book for—

I.—Disobedience of orders.

II.—Absence without leave.

III.—Idleness in the school or in the workshops.

IV.—Insubordination or disrespect to the Superintendent or their instructors.

V.—Frequent entries in the conduct register for petty offences.

19 Students may be removed from the College for habitual or gross misconduct, or for continued idleness or negligence in the workshop or in class. The order for removal will be issued, in the case of engineer and overseer students, by the Director of Public Instruction; in the case of mechanical apprentices, by the Superintending Engineer.

20. Every student will be responsible for any machines, tools, or other articles that may be placed in his charge; he must produce them when called for, and must at once report any damage done to them.

21. A Monitor of Discipline, and Dormitory and Workshop Monitors, will be appointed by the Superintendent; the former will receive Rs. 4, and the latter Rs. 3 and Rs. 2 a month respectively. They may be removed by the Superintendent for misconduct, or for inability to discharge the duties assigned to them.

22. European and Eurasian students residing on the College premises will take their meals at a common mess, for which all necessary arrangements will be made under the orders

of the Superintendent. To students of the engineer class, and to apprentices in excess of the number admitted at the reduced rate (*see* Rule 6), a charge of Rs. 15 a month will be made for the cost of their mess. On joining the mess each student will pay an entrance fee of Rs. 10 to the mess fund, to provide for the cost of crockery, knives and forks, table-linen, &c. A list of the breakage and other damage done will be read out at the end of every month, and each student will be required to pay, by the 15th of the following month, an equal share of the cost. On leaving the mess, if a student has paid all demands, his entrance fee will be returned to him; otherwise it will be forfeited to the mess fund.

23. In addition to the Monitors, the Superintendent will from time to time, select some out of the resident students for certain responsible duties connected with the mess and with the internal management of the College. These duties at present are as follows :—

Mess Orderly.—One student will take up this duty daily. He will draw from the steward the quantity of food required for the day, see it weighed, and enter the amount in a book to be kept for the inspection of the Superintendent. He will see that the cooking utensils are clean, and the cook-house in order. At 5 P.M. daily, or after dinner, he will see that the cook-house premises are washed and swept, and the drains flushed; reporting all clean to the Superintendent

Compound Orderly — Two students will be on duty from 6 to 7 A.M. for a week to superintend the coolies and sweepers in cleaning up the compound, sweeping leaves, and keeping the drain clear. One orderly will be relieved on Thursday, the other on Saturday. The senior orderly will report daily to the Superintendent, before 8 A.M., that the compound is clean

24 Native students residing on the College premises will make their own arrangements for messing, under rules to be framed by themselves and approved by the Superintendent. They will also be required to keep their houses and the drains and compound about them clean, under the general control of the Superintendent

25 Native apprentices messing under the foregoing rule will pay Rs. 3 monthly towards the cost of their mess; and the balance, up to a limit of Rs. 5 monthly, will be paid for them by the Superintendent.

26. The names of all servants employed by the native students under Rule 24 must be entered in a book to be kept for that purpose by the President of each mess, and shown to the Superintendent called when for.

27. No resident student will be allowed on any account to keep a private servant. European and Eurasian students of the engineer class may, however, with the permission of the Superintendent, and on condition of paying the cost incurred, be allowed the assistance of extra servants in their dormitories. Such servants will be servants of the College, and under the orders of the Superintendent.

28. The Superintendent will from time to time issue such rules as he may think necessary for securing attendance out of school and workshop hours, and for maintaining the discipline and cleanliness of the dormitories, mess-houses, &c., whether for European and Eurasian or for native students.

29. Leave of absence will be granted to resident students from 6 A.M. on the last Saturday of every month to 8 A.M. on the following Monday. Such leave must be asked for not later than noon of the previous day. Resident students of the engineer and overseer classes must apply in writing to the Principal, who, if he grants the leave, will initial the application. The student will then take the application to the Superintendent, who will retain it. Students of the apprentice class will apply directly to the Superintendent.

Students who take no leave under this rule will be under the orders of the Superintendent as to the disposal of their time.

30. No other leave will ordinarily be sanctioned. If special leave be given, it will be granted by the Principal to students of the engineer and overseer classes, and by the Superintendent to apprentices; the necessary information being made to the Superintendent or the Principal, as the case may be

31. On Sundays resident Protestant students will be required to attend the service held in the College chapel. Roman Catholics will be allowed to attend their own services within hours to be fixed by the Superintendent.

32. All resident students of the College will be required to wear a uniform dress, which will be supplied to them at cost price.

33. All resident students, European and native, will be allowed to join the Volunteer Cadet Corps.

A. W. CROFT,

Director of Public Instruction.

The 12th June 1880

Note by MR. S. F. DOWNING, *Principal of the C. E. Dept. of the Presidency College.*

BEFORE proceeding to give my views on the question of education for the engineering profession in India, I must state what appears to me to be the distinction between a *mechanical* and *civil* engineer; viz., the former is a highly educated mechanic, whilst the latter, in addition to his other acquirements, ought to be capable of designing machinery, &c., but need not be a *mechanic*. I am aware that it is a vexed question amongst professional men where to draw the line, but assuming that my distinction is a tolerably correct one, it follows at once that the course of study adopted by each ought to be widely different

2. The theoretical course suggested by Mr Croft in paragraph 62 of his paper, in my opinion, embraces all necessary subjects, with one exception. I do not think that elementary optics ought to be omitted from the civil engineer's course, as without some knowledge of that subject a student cannot properly understand his surveying instruments. I most cordially approve of the introduction of differential and integral calculus into the course.

3. The Civil Engineering Department of the Presidency College partially educates natives and others for the civil engineering profession generally, but more particularly for the post of Assistant Engineer in the Public Works Department, and I cannot think that it would be advisable to separate that department from the college. I have learned from conversation with respectable educated natives that the fact of the department belonging to the Presidency College gives it a certain status in the eyes of native society; consequently a superior class is attracted to it than would be the case were a school attached to large Government workshops in which the students would have to work daily, such manual labour being, unfortunately, considered derogatory by upper class Bengalis. This appears to me to be an important point, because native Assistant Engineers, Public Works Department, have to associate officially with English gentlemen, and consequently the former ought, if possible, to be recruited from the *upper* middle class community.

4. My scheme for educating Civil Engineers for employment in the Public Works Department or for private practice is as follows:—The Civil Engineering Department of the Presidency College will receive into its classes *only* aspirants for the University license, the course to be as now for three years. The candidate having passed the L. C. E. examination, but *before* he receives the license from the University, will spend one year in the shops (I assume that the large workshops mentioned in Mr. Croft's paper are in full work), and second year will be passed as a pupil under an Executive Engineer, with whom the candidate will learn the routine of Assistant Engineer's work, and will be brought into actual contact with practical operations. At the termination of the fifth year, if favourably reported upon to the University by the officer in charge of the shops, and by the Executive Engineer, the University will bestow upon the candidate the license in Civil Engineering. If some such scheme as the above was adopted, and if Government would guarantee at least two appointments yearly to licentiates, I am convinced that the result would be much more satisfactory to the University, the Government, and to the students, than if as at present. It would be quite ineffective to guarantee only one appointment, as I find there is invariably one smart boy in each class with whom the others have not sufficient energy to compete.

5. This matter of guaranteed appointments cannot, I think, be too strongly impressed upon Government. It appears to me almost unreasonable to look for energy and activity amongst students when their chances of ever receiving professional employment are so remote as they are at present. Private enterprise may open out a brilliant future for engineers in India, but the present generation must, I fear, look to Government for employment.

6. As no certificate would be granted by the Principal of the Presidency College qualifying for either overseer or sub-overseer grade, the first and second year classes would be much reduced in numbers; consequently a corresponding reduction might be made in the instructive staff of the department, the Professors no longer required being drafted into the technical school.

7. I quite agree that even a perfect knowledge of a fragmentary portion of the Civil Engineer's course can never make a useful overseer, and my views upon the subject of educating for that grade coincide with those expressed by Mr. Croft; but at the same time I hardly think that it is necessary that an overseer "must labour with his own hands at as many branches of work as he will be called upon to supervise." Take for instance *stone-cutting*. A man who was seen much of this work can tell whether or not a stone is properly dressed, although he himself may never have used chisel and mallet.

8. In overseer as in engineer grades, there is a marked distinction between the mechanical and civil branches; nevertheless, the civil overseer ought to be essentially a *workman*, and as such he ought to be educated in the school attached to the shops, which he would join knowing that he must work with his hands; consequently he would be, I think, of a different class from those who would join the Presidency College, L. C. E. class.

9. A sub-overseer ought, in my opinion, to be selected as proposed in paragraph 41 of Mr. Croft's paper, just as the sub-engineer grade ought to be filled up by the most ingenious and intelligent overseers.

11. As I am not a mechanical engineer, I feel somewhat diffident as to expressing my views on the requisite training for that profession. The course suggested by Mr. Croft appears to be an admirable one, and I would merely remark that if the embryo mechanical engineer is to spend some of his time in practising surveying in the field, a portion of his theoretical course ought to be devoted to that subject. It has been aptly said that "an engineer ought to know *something* about *everything*;" but a line must be drawn, and I hardly think that it can be at all necessary that a mechanical engineer should also be a land surveyor. He might, however, be taught the use of levelling instruments, and such knowledge would be useful to him in the event of his being called upon to erect large machinery.

Circular No. 95P.W., dated Simla, the 20th October 1869.

RESOLUTION—By the Government of India, Public Works Department.

Supply of Upper Subordinates.

RESOLUTION.—The Governor-General in Council has had under consideration the very important question of the best mode of recruiting the Upper Subordinate establishment. The present sanctioned strength of this branch of the establishment under the Government of India is 618. In the ordinary establishment, *i.e.*, exclusive of railways, there are now more than 50 vacancies The average number of casualties from all causes during the last 10 years has been 10 per cent. By this time next year there will have been at least 62 casualties. To keep up, then, the existing strength there must be an addition of 112 Upper Subordinates.

2. The number sanctioned on the 1st April 1868 was 431, and on the 1st April 1869, 564. The establishment therefore increased by 133 in 12 months. If the same rate of increase is maintained, the addition to the Department by October 1870 should be 245. But the reduction of ordinary Public Works expenditure will certainly set free some Upper Subordinates for employment on Extraordinary Railway and Irrigation works. The *present* wants of the department, however, are 60 or 70 men yearly to fill vacancies caused by casualties, and 50 or 60 to fill up existing vacancies. There is, besides, the prospect of a considerable, but at present unknown, expansion of the department for the new Irrigation Works and Railways in prospect.

3. To meet these wants the Thomason College may be looked to for an annual supply of 80. Probably about 6 may be expected from the Presidency College. Also a number f qualified men are picked up independently. It is possible that these sources of supply will, for the present at least. suffice for the ordinary work of the department.

4. But with the expansion of Public Works and the construction by the State of extensive irrigation and railway works, a necessity has sprung up for a considerable number of artificers specially experienced in ironwork, machinery, brick-making, &c, and the Government must look elsewhere than India for them, and it appears to the Governor-General in Council that suitable men may be obtained not only from England, but from other countries, and particularly Belgium and Germany.

5. The classes of men required are those skilled respectively in—

Carpentry.	Ironwork.
Brick and tile-making.	Machinery.
Stone masonry.	Brick-laying.

The men should be of the foreman class, having complete practical knowledge of their trades, and too great theoretical attainments should not be expected, and the mistake of 1856 should not be repeated, under which young men desiring to become engineers were sent out as Upper Subordinates in ignorance of the difference between the two classes of establishment.

6. It is understood that men of this class could be obtained for about Rs. 200 per mensem, but on this point it is not necessary to be precise, and it will vary with the different classes of workmen and individual qualifications. Their salaries can be determined on a reference to their former employers. They would no doubt often be glad to give assistance and advice as to the best method of procuring them in England. They should be engaged on analogous terms to those under which the Senior Civil Engineers have been brought out, of which the main feature is, that they are bound to serve 5 years, and the Government has the option of dispensing with their services after 3 years, giving them, if discharged without fault, six months pay and a free passage home Beyond their professional qualifications, a fair knowledge of reading, writing and arithmetic is all that is essential for this class of subordinates.

7. It may be better not to advertise in the Continental papers in the first instance, but some Engineers. Military and Civil, who may be duly qualified, now in England, might be deputed to visit the centres of labour in Germany and Belgium, and with proper introductions they would learn the readiest way to attain their object. At first, the number of foreigners should be small in order that the Government may have experience of the difficulties in the way of language, &c.

8. It is essential that married men with large families should not be sent out.

9. It remains to determine the number that should be engaged. The Governor-General in Council considers that a commencement may be made by employing 30 men, of whom 8 might be foreigners. About equal numbers might be engaged in the several classes. These arrangements will require to be completed with the co-operation of the Secretary of State, who should be addressed on the subject.

10. It will be observed that in estimating the number of men obtainable from every source in India, no account has been taken of Royal Engineer soldiers from England, who qualify at the Regimental School of the Sappers and Miners, and are admitted on a certificate from the Commanding Officer. In practice, the department has not obtained any help from this source worth mentioning, and on further consideration of the matter the Governor-General in Council can see no reason why those men, like other soldiers, should not qualify at the Thomason College, so that the number

of soldiers admitted to the department must be held to be limited by the powers of the college. The Military Department should be informed of this, and that the Government of India in this department considers it expedient that Royal Engineer soldiers volunteering for service in India should be given to understand that before admission into the Public Works Department they must pass through the Roorkee College course, and the requisite change should be made in the notices issued in England calling for volunteers for India. This of course does not apply to soldiers having practical qualifications, who are admitted into the department under Public Works Code II, ii, 28. These men will usually be posted after one year's residence with the Sappers and Miners.

11. In order that the increased number of students at the Thomason College may be accommodated, application will be made to the Military Department for the use of one or more of the empty Sapper barracks at Roorkee. The Government, North-Western Provinces, should at once cause an estimate to be prepared for the needful school building for 100 students in the 2nd Department. Proposals for an increased staff have been received, and will be considered separately.

12. But while making provision for a larger supply of soldiers for the department, the Governor-General in Council considers that greater efforts should also be made to enlarge the native classes at the college, and desires that a report may be called for from the Principal on the subject.

13. It is understood that the Principal will have no difficulty in filling up his increased numbers of soldier-students this year, but at the cost of lowering the Entrance Standard. This will be done to meet the exceptionally large demands of the Public Works Department. It is highly desirable, however, that the men should be as fully educated as possible before their admission into the college, where the course of study only extends over 10 months. The Regimental schools should be able to impart the not very large amount of knowledge required for the Entrance examination at Roorkee, and the fact that they apparently do not do so to an extent bearing any proper proportion to the strength of the Army in India should be brought to the notice of His Excellency the Commander-in-Chief, with the request that he will offer any suggestions on the subject of improving the Regimental schools that may appear to His Excellency suitable. The great importance of attending to these institutions is impressed on the Government of India in this Department, not merely with reference to the present demand for subordinates in the ordinary Public Works Department, but also in view of the call for guards and subordinate Traffic Agents on the State Railways which are about to be put vigorously in hand, for which class of posts well-behaved soldiers would be admirably suited.

ORDER.—Ordered that this Resolution be communicated to the Local Governments and Administrations noted in the margin, and to the Military Department with a view to the subjects noticed in paragraphs 10 to 13 being further considered and dealt with in that department, and to the Financial Department for information. The early attention of the Government, North-Western Provinces, is directed to paragraphs 10 and 11.

Governments of Madras, Bombay, Bengal, North-Western Provinces, Punjab; Chief Commissioners, Central Provinces, Oudh, British Burmah, Mysore, and Coorg; Resident at Hyderabad; Agents to the Governor-General in Central India and Rajputana.

Circular No. 35P.W., dated Simla, the 29th June 1870.

RESOLUTION—By the Government of India, Public Works Department.

Training in India of Natives for the position of Foremen Mechanics.

READ again—

Public Works Department circular No. 95 of 20th October 1869.
Despatch No. 159 of 29th November 1869, to the Secretary of State.

Read also the following despatch:—

No. 15, dated London, the 10th March 1870.

From—The Secretary of State for India,
To—The Government of India.

I HAVE duly received your Excellency's despatch No. 159 of 29th November last, forwarding copy of a Resolution recorded by your Government on the best mode of recruiting the Upper Subordinate Establishment of the Public Works Department, and recommending that thirty European artificers be engaged and sent out for service in that department.

2. I have directed that suitable steps be at once taken for complying with this requisition, which I trust, however, is not intended to be frequently repeated. The class of men asked for are not such as it is expedient to introduce in large number into India, where, in the intercourse between Europeans and Natives, more consideration for the feelings and prejudices of the latter is desirable than such of the former as have not had their manners softened by education are much in the habit of showing. Probably, the importation from Europe of skilled foremen may have been considered necessary at the commencement of the large railway and irrigation works about to be undertaken, but those works will themselves constitute an unexceptionable training school, and your Government will doubtless impress on the executive officers the importance of taking full advantage of the opportunities thus afforded of training both Natives and Europeans for the position of foremen mechanics.

3. I am informed, too, that there are generally in India a good many European artizans and artificers who, having been brought out by railway or other contractors for some special service, remain, after its termination, for a while at large. Others of the same description, who

were formerly engaged in the Government Dockyard at Bombay, may not improbably still be in the country without regular employment. How far by keeping a constant look out for men so circumstanced, and with the assistance to be obtained from Roorkee, it would be possible to recruit the Upper Subordinate Establishment, your Excellency must be best qualified to judge.

OBSERVATIONS.—In dealing with the important question of the best mode of recruiting the upper subordinate establishment of the Public Works Department, it was considered that the demand for artificers, especially experienced in ironwork, machinery, brick-making, &c., which the construction of railways and large irrigation works by the State had created could not be fully met in India, and that such skilled workmen should be drawn in a great measure from England and other places in Europe. The Secretary of State was accordingly requested to take the necessary steps in the first instance to engage and send out to India thirty men of this class who had complete practical knowledge of their several trades.

2. The Secretary of State intimates in his reply that orders have been issued for meeting the demand; but, for the reasons stated in the despatch, expresses a hope that such requisitions will not be frequent.

The Governor-General in Council remarks that when it was determined to obtain artificers from Europe, the Government of India was fully alive to the objections to importing this class of men largely into the country, and it was the intention to look to Europe for a supply only until the Public Works Department was in a position to train such men in the large Government works about to be undertaken. There is practically, therefore, no difference in the views entertained by the Government of India and the Secretary of State on this point.

4. But His Excellency in Council considers that the opportunity may usefully be taken to impress strongly on the several Local Governments and Administrations concerned and on the superior officers of the department, the great advantage of endeavouring, as far as possible, to train the natives of this country in all those branches of handicraft that are necessary to the construction and maintenance of railways. It may not be possible to dispense altogether with European artizans; but there is little doubt that much more can be done than has hitherto been attempted in the direction of employing native artificers, especially in the lighter descriptions of ironwork.

5. As large railway and irrigation works are put in hand, it can scarcely be expected that the local supply will altogether meet the demand for specially qualified men of the class in question; but every large work of the magnitude of a railway or canal, and every shop in connection with such, forms a training school for artizans; and from those there is no doubt that some suited for the position of foremen could be obtained. To ensure this result it will probably be necessary to attach a school to each large shop, which likely men should be encouraged to attend, and those that give promise of rising to the responsible position of foremen should be helped, and their practical knowledge supplemented with theoretical training and some instruction in drawing. The success of the experiment will of course depend mainly on the tact, judgment, and energy of the men at the head of the shops; but His Excellency in Council sees no reason to doubt the successful issue of the experiment if the object is put before these supervisors as one to which the Government of India attaches much importance, and if the Local Governments interest themselves in securing its accomplishment.

6. Of course it is to be clearly understood that there is no desire on the part of the Government of India to raise the Natives to the responsible position above indicated, unless it can be clearly shown that their employment is not likely to interfere with efficiency of work. All that is intended is to make well-directed and persistent efforts so to qualify natives as to justify their employment in the position of foremen.

7. His Excellency in Council cannot too strongly commend this matter to the careful consideration of the Local Governments and Administrations, and will be glad to receive and consider any suggestions which they may desire to offer, and which are calculated to further the attainment of the important object in view.

Governments of Madras, Bombay, Bengal, the North-Western Provinces, and the Punjab.
Chief Commissioners of the Central Provinces, Oudh, British Burma and Mysore and Coorg.
Resident at Hyderabad.
Agents to the Governor-General for Central India and Rajputana.

ORDER.—Ordered that a copy of this Resolution be forwarded to the Local Governments and Administrations marginally noted.

No. 538—42E.R., dated Fort William, the 4th June 1874.

RESOLUTION—By the Government of India, Public Works Department.

Training of Natives for employment as Engine-drivers, Mechanics, and Plate-layers on State Railways.

Read—

Letters from the Engineer-in-Chief, Holkar State Railway—
No. 582 of the 9th February 1874.
No. 936 of the 25th ditto.

OBSERVATIONS.—In these letters the Engineer-in-Chief has brought under consideration the desirability of taking special steps to obtain for the State Railways a supply of native skilled labour and supervision, more particularly as Inspectors of Masonry, Plate-layers, Engine-drivers, and Fitters, &c. It is suggested that a few good Sub-Overseers from the Thomason College at Roorkee might be attached to open lines of railway and to lines on which

plate-laying is in progress, and placed under an Inspector to learn the work; that others should be put to learn practical stone-cutting and setting, and others be apprenticed in the locomotive shops of the existing railways If efficient men can be trained, the advantages, it is represented, will be found in lower salaries, and the power of more constant attention to duty irrespective of climate, than is generally possible with Europeans.

2. The Government of India has long had this object in view. It is impossible that the extension of railways can be carried out so that they may become completely an institution of the country, unless the working in all departments can be conducted by native agency with a moderate amount of European supervision. This end has therefore to be arrived at gradually as railways extend.

3. Again, there is an additional reason in the consideration that, taking a wider view of the progress of education in a country, such education is not complete unless a proportion of the population is trained to practical mechanics, and especially the branches of mechanics now so largely cultivated in Europe and America in the service of railways.

4. No doubt the mere introduction of European skill and European appliances in various manufactures and public works, especially railways, which has taken place to a large extent of late years, does produce an unpremeditated education in mechanics. In this way, with occasional efforts at systematic training, much progress has been made. Natives who can manage a steam-engine have, for many years, been found in the Presidency towns. There are even now a few natives capable of driving a locomotive engine, though many Engineers of experience express doubts whether the nerve and readiness of mechanical resource required to make a good driver are likely to be found largely amongst the natives of India.

5. The Government of India is of opinion that the time has now come to make a systematic attempt to train native engine-drivers and mechanics of all kinds, as well as plate-layers, for the service of the State Railways to assist the European agency in this department.

6. In this way a large field of employment will be opened to natives possessed of the necessary qualifications, and the opening of a new source of supply of mechanics for the railways will enable the Government to enlarge the number of these employés at less cost than if the supply were to continue to be restricted to men imported at a heavy cost from England.

7. In regard to plate-laying, the Government of India considers that the object may be attained by allowing to the Inspectors on the various State Railways an apprentice fee for every native they instruct and turn out as a really qualified foreman plate-layer, capable of superintending the maintenance of 20 to 30 miles of railway. The Governor-General in Council desires that the experiment may be tried without loss of time. For such men as may qualify, employment on a monthly rate of pay of Rs. 20 and upwards will readily be found. The Director of State Railways should take action at an early date and decide as to the amount of fee that should be offered.

8. As respects the instruction of natives as engine-drivers, it is of course essential that a driver should have served in workshops, and be qualified not merely to keep his engine in good order and drive it, when all goes well, but to find out and rectify anything that goes wrong. Few natives have, as yet, passed from the shops to be drivers, or been employed as such. The Government of India is not disposed to accept the conclusion that this state of things cannot be remedied. With a proper selection of intelligent men, physically fitted for such work, and with careful training both in and out of the shops, a better result may be looked for, more especially with the lighter engines and slower speed of the metre-gauge lines It will, no doubt, be very necessary to place the shoptraining under men who will take an interest in the results, and to select very carefully the Shed Foremen in view to the introduction of native drivers so as to ensure a close control over the men, and especially as regards the proper care of their engines. The Director of State Railways should take up this matter also at an early date.

9 In connection with this subject generally, it has been suggested that an attempt should be made to train some of the native Sappers and Miners to the duties connected with the construction and working of railways. Suitable occupation could readily be found for them in times of peace, and in times of war they might prove of great use. The matter should be referred for consideration in the Military Department. Should the idea commend itself to the Military authorities, it would be easy to arrange on the State Railways for the training of a company or of a selected portion of each company in all the special details of railway construction and maintenance, and it is probable that from amongst such a number of men individuals would be found willing to go through a course of training in workshops and as engine drivers

ORDER.—Ordered that a copy of these observations be forwarded to the Director of State Railways.

Also that a copy be forwarded to the Military Department for consideration with reference to paragraph 9.

Also that copies be forwarded to the Consulting Engineers to the Government of India for Guaranteed Railways for information.

Nos. 894-913ER, dated Fort William, the 4th December 1874.

RESOLUTION—By the Government of India, Public Works Department.

Training of Natives for employment as Engine-drivers, Mechanics, and Plate-layers on State Railways.

READ—

No. 139R., dated 30th September 1874.

From—The Secretary of State for India,
To—The Government of India.

WITH your Excellency's letter of the 17th August last, No. 153, I have received a copy of your Resolution, dated 4th June, No. 538ER, on the subject of the supply of native skilled labour and supervision for State Railways.

2. This is an important question if viewed only with reference to the economical construction and working of the lines, and it has afforded me much gratification to read your Excellency's "observations" on the subject, in all of which I entirely concur. I trust that, as the works progress, and the prospect of regular employment becomes more assured, it will not be found difficult to train natives of India to act as inspectors, plate layers, drivers and fitters, in sufficient numbers to meet the wants of the department.

ORDER.—Ordered that a copy of this despatch be forwarded to the Military Department, and to the Local Governments, Administrations and officers noted in the margin for information, with reference to Public Works Department Resolution No. 538ER, dated 4th June 1874.

The Governments of Madras and Bombay.
The Governments of Bengal, the North-Western Provinces, and the Punjab, in the Public Works Department.
The Chief Commissioners of Oudh, the Central Provinces, British Burma, Mysore and Coorg, and Assam.
The Resident at Hyderabad.
The Agents to the Governor-General for Central India and Rajputana
The Superintendent of Port Blair and Chief Commissioner of the Andaman and Nicobar Islands.
The Inspector-General of Military Works.
The Accountant-General, Public Works Department.
The Director of State Railways.
The Consulting Engineers to the Government of India for Guaranteed Railways, Calcutta, Lahore and Lucknow.

Nos. 1598—1615EG, dated Fort William, the 27th November 1876.

RESOLUTION—By the Government of India, Public Works Department.

Training in India of Natives for the position of Foremen Mechanics.

Read again :—

Public Works Department circular No. 35 of 29th June 1870.
" " " Resolution Nos. 335—45EG of 8th March 1871.

Read also :—

Letter from Government, North-Western Provinces, No. 2242 of 21st March 1872.
" " " " No. 50EC of 23rd May 1876.
" " " " No. 225EC of 9th August 1876.

RESOLUTION.—In the circular of 29th June 1870, No 35, the Government of India strongly impressed on Local Governments and Administrations, and on the superior officers of the department, the great advantage of endeavouring, as far as possible, to train the natives of this country in all those branches of handicraft that are necessary to the construction and maintenance of railways. It was at the same time remarked that every large work on a railway or canal, and every shop in connection with them, forms a training school for artizans; that from these there was no doubt that some men suited for the position of foremen could be obtained, and that to ensure this result it would probably be necessary to attach a school to each large shop which likely men might be encouraged to attend, and where the needful education and scientific knowledge could be imparted to those that gave promise of rising to the position of foremen.

2. The Government of Bengal has given effect to the wishes of the Government of India in establishing a training school at Dehree for European, Eurasian and native youths, and the Government of the North-Western Provinces has also submitted proposals for giving the necessary training to artizans in the workshops and schools at Roorkee.

3. It was decided by the Government of India that the expenditure connected with the training schools at Dehree should be a charge against the ordinary Public Works Imperial grant. His Honour the Lieutenant-Governor of the North-Western Provinces suggests that the same course might be followed in connection with the experiment at Roorkee, but that the Local Government, which would reap the benefit of obtaining the services of a trained foreman, should re-imburse the Imperial Exchequer the cost of the foreman's three years' education at a rate to be fixed by the Government of India.

4. After giving the question of the incidence of the charge, which the establishment of these training schools will involve, careful consideration, it seems to the President in Council that it will be better to localize these arrangements so that each Local Government or Administration and each branch of the department shall train men for employment in the province or branch. Local Administrations which have not the means at their disposal for imparting the necessary training might, it is thought, arrange with neighbouring provinces—thus Assam might arrange with Bengal for the training of its men. By this means a self-acting

arrangement would be established without the Government of India incurring any charge for general training establishments or becoming liable to find employment for men trained for general service; as each Local Government and Administration, and each Imperial Branch of the department would bear the cost of training its own men from Imperial, Provincial or Local Funds as the case may be.

5. Before finally deciding on the adoption of this arrangement, the Government of India will be glad to receive any suggestion which Local Governments and Administrations and Heads of Departments may desire to offer on the subject.

The Governments of Madras and Bombay in the Public Works Department.
The Governments of Bengal, North-Western Provinces, and the Punjab, in the Public Works Department, General and Irrigation Branches.
The Chief Commissioners of Oudh, Central Provinces, British Burma, Mysore and Coorg, and Assam.
The Resident of Hyderabad.
The Agents of the Governor-General for Central India and Rajputana.
The Inspector General of Military Works.
The Director of State Railways.

ORDER.—Ordered that a copy of this Resolution be forwarded to the Local Governments, Administrations, and officers noted on the margin for the purpose indicated.

Circular No. 71P.W., dated Fort William, the 17th December 1877.

RESOLUTION—By the Government of India, Public Works Department.

Incidence of the charge for training in India of Natives for the position of Foremen Mechanics.

READ again—

Public Works Department Resolution Nos. 1598—1615E.G. of 27th November 1876.

Read also—

Replies to the above.

RESOLUTION.—The majority of the local authorities consulted on the subject being in favour of the proposal to localize the arrangement for the training of natives for Foremen-Mechanics, as suggested in paragraph 4 of Public Works Department Resolution Nos. 1598—1615E.G. of 27th November 1876, the Government of India is pleased to decide that this arrangement shall be adopted in future.

It is now left to the Local Governments and Administrations, and to Heads of Imperial Branches of the Department, to give effect to the measure, to which the Government of India attaches much importance.

The Governments of Madras and Bombay, in the Public Works Department.
The Governments of Bengal, North-Western Provinces and Oudh, and Punjab, in the Public Works Department, General and Irrigation Branches
The Chief Commissioners, Central Provinces, British Burmah, Mysore and Coorg, and Assam.
The Resident, Hyderabad.
The Agents to the Governor-General for Central India and Rajputana.
The Inspector General of Military Works.
The Director of State Railways.

ORDER.—Ordered that a copy of this Resolution be forwarded to the Local Governments, Administrations and officers noted on the margin for information and guidance.

BEHAR INDUSTRIAL SCHOOL.

Note by COLONEL STANTON, *dated 3rd September* 1880.

As the funds of this institution are now able to bear the cost, I think the scheme of education sketched out in Mr. Croft's note of the 9th August 1876 should be put in practice; but I believe the practical work will be rendered more useful if a regular workshop, where ordinary kinds of work can be turned out, is attached in order that the student may see finished work properly turned out, as well as learn themselves by degrees how to execute work of all kinds. For this purpose I would have two or three good carpenters (Chinamen for choice) and the same number of blacksmiths entertained.

In a large city like Patna there must always be a demand for workshop articles. I would have a small brass foundry, as well as a carpenter and blacksmith's shop, but at first I would not recommend an iron foundry. I believe these shops would soon be self-supporting, while the students would be learning their work really practically, and as the work demanded increased, the paid establishment of workmen would be increased and more machinery be supplied. Machinery sufficient for a small workshop should be procured at once and set up, the building at present occupied being properly repaired and fitted, the smithy being removed into the next compartment. The school part of the building should be also repaired and furnished with proper desks, forms, drawing tables, &c., &c.

The Executive Engineer of the Patna Division and the District Road Cess Engineer should be placed *ex-officio* on the School Committee, and should be asked to assist the attached workshop by ordering such work as they required to be executed in the shops. I am disposed to think that a good European foreman mechanic should be in charge of the workshop, and a carefully selected native made Superintendent of the school, as the students will be natives.

Note by MR. LEVINGE, *dated 8th September* 1880.

I AGREE with Colonel Stanton in thinking that Mr. Croft's scheme should be carried out, and that a regular workshop should be started in connection with the school. Its success will in a great measure depend on the proper selection of instructors. The foremen should be thoroughly competent, and able to work with their own hands, so as to be capable of imparting practical instruction, and of showing the boys the use of the tools with which they have to work. English tools only should be used both in the carpenters and blacksmith's shops, which should be provided with proper benches and forges respectively.

At first, I think, it will suffice to provide the following machines :—1 Screw-cutting lathe, 1 Smaller lathe, 1 Screw-cutting machine, 1 Small shaping machine, 1 Drilling machine, 1 Punching and shearing machine. All these to be driven by a 12 or 14 horse-power (nominal) portable engine. If a saw bench is procured (and if funds are available it should be got), it should be driven by a separate engine in the carpenter's shops, because when anything like heavy work has to be done a circular saw pulls up the engine, and diminishes the speed at which the other machinery should be driven.

I think it probable that an iron foundry would prove remunerative at Patna, but the plant is rather expensive, and a separate building would have to be erected for it. If money is available, an iron foundry might be established, but I should be inclined to postpone this part of the work for the present—at all events until it is seen what the cost of the tools and machinery above mentioned is. A small brass foundry may, however, be started without incurring much expense.

In this school, I think, each boy should be taught a particular trade—carpenter, smith, fitter, &c.—but all should be instructed in the use of blocks, screw-jacks, crab-winders, erection of shear legs, &c. A knowledge of even one of these mechanical contrivances would be most useful on works, and probably enable a mechanic to earn better wages and secure a better position than if he were ignorant of them.

Note by MR. CROFT, *dated 9th September* 1880.

THIS file was made over to me at Bankipore in reference to an offer made to the Magistrate by Lutf Ali to give a lakh of rupees for the "instruction of his Mahomedan co-religionists in the arts and sciences" (as nearly as I remember). This was understood to be tantamount to an offer of a lakh of rupees to the Bankipore Industrial School, and Colonel Stanton, Mr. Levinge and myself were asked to consider how the offer could be utilized. Their notes are below.

The scheme of mine to which Colonel Stanton and Mr. Levinge refer will be found as an enclosure of my No. 2244, dated 26th April 1877, just below I entirely agree with Colonel Stanton in thinking that a regular workshop should be established in which the students may see finished work properly turned out (*see* my No. 1234, dated 1st March 1880). In deference to his opinion, in which Mr. Levinge concurs, I would postpone the setting up of an iron foundry for the present. The shops might be started with the tools and plant named by Mr. Levinge, but an iron foundry should be looked forward to as soon as the position of the shops justifies such an extension of the work. As regards the school, there is a capital native in charge of the workshop school at Dehree, which, in consequence of the transfer of most of the plant to Howrah, and a reduction in the number of workmen, is now languishing and may have to be closed. He is specially qualified for a school of this kind, and, for the present at any rate, would be able to do all that is required.

Lutf Ali's offer will probably be shortly, if it has not already been, communicated by the Commissioner to Government. It will raise the funds in hand to about Rs. 1,80,000, and allowing Rs 30,000 for plant, there will remain 1½ lakhs for investment, yielding an income of Rs. 500 a month. Government has already promised Rs. 250 a month as a grant-in-aid if the industrial school can be satisfactorily established. On receipt of the offer, the Commissioner might be asked to make definite proposals as to the basis and scale of establishment on which the school should be conducted.

W. J.—Reg. No. 9647C—64—7-12-86.